THE MODEL ENGINEER

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The MODEL ENGINEER

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7TH JUNE 1951 VOL. 104 NO. 2611

SMOKE RINGS

Our Cover Picture

● YACHTING, BOTH in full-size practice and in model form, is well represented at the Festival of Britain South Bank Exhibition. In the sports section there is a series of model yachts floating in a pond, representing each of the popular classes. The yachts may be changed from time to time, as any of them may be required for racing at various regattas. The photograph on this week's cover shows a Marblehead or "M" class boat. This class was introduced into this country from the United States a few years before the war, and owing to its convenient size and the simple formula which governs its design, it has become one of the most popular classes. The basic feature of the formula is that the overall length of the hull must not exceed 50 in. and the total sail area must not exceed 800 sq. in. Other dimensions such as beam, draught and height of mast are unrestricted. In order to take full advantage of the restricted hull length, designers often dispense with overhangs, using the full 50 in. as W.L. sailing length. A further development is to fill out the deck lines fore and aft as they would be for a longer hull having overhangs. The ends are then cut off at the 50 in. and rounded or faired into the hull. This gives a longer waterline when the boat is heeled, and as waterline length is a function of the basic speed of the boat, such a boat usually shows up better in racing. The boat shown in our photograph is of the more orthodox type; it is also fitted with the Braine type of steering gear. The modern tendency is in favour of the Vane steering gear which is more sensitive to the actual direction of the wind rather than, as in the Braine gear, the strength of the wind. However, these and the innumerable other aspects of model yachting are discussed more fully in our companion magazine, *Model Ships and Power Boats*, published monthly, price 1s. This magazine covers all the different interests in ship modelling, from historical ships to modern model yachts and hydroplanes, and should be in the hands of all interested in marine models.

"M.E." Exhibition Prizes

● SECRETARIES OF ship model clubs are reminded that the "M.E." Ship Model Societies Trophy is open for competition by all such clubs exhibiting at THE MODEL ENGINEER Exhibition.

Last year the trophy was won by The Sheffield Ship Model Society, and we hope that they will have greater competition this year.

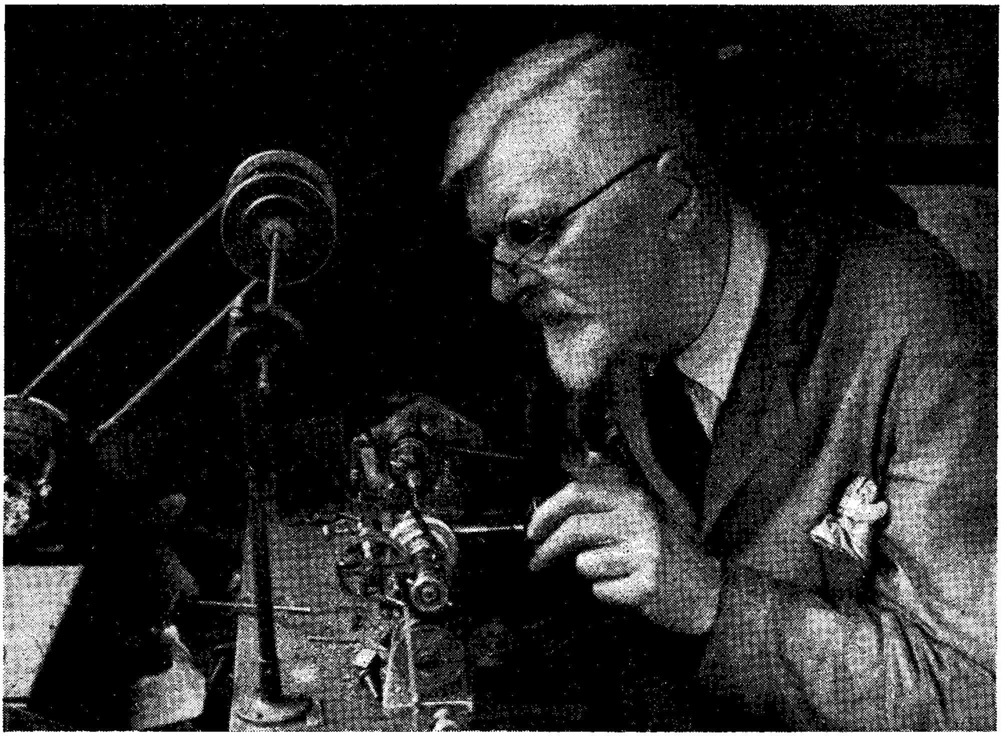
This trophy, donated by Mr. M. Maltby, is a fine model of a ship's steering wheel bearing shields on the rim commemorating the award to the successful club. In 1959 the society registering the greatest number of wins on the trophy will retain it permanently, and engraving to that effect may be inscribed on the centre boss of the wheel.

Mrs. Willis has kindly donated "The Willis Cup" to be awarded annually for the best exhibit in the hydroplane and speed-boat section at

THE MODEL ENGINEER Exhibition. The cup is given in memory of her husband who never missed an "M.E." Exhibition and was one of the most active model engineers in Ireland.

The Maze Cup, donated by Sir Frederick Maze, K.C.M.G., K.B.E., for the best model of a sailing ship (pre-1820) or of an Oriental sailing craft of any period. Sir Frederick Maze was formerly the Inspector-General of the Chinese Maritime Customs Service and Administrator of the Chinese Lighthouse Department, 1929-1943.

A prize of three guineas kindly offered by our contributor "Kinemette" for the best example of optical apparatus constructed from his designs in THE MODEL ENGINEER.



A Master Craftsman

● WE VERY much regret to learn of the death of Mr. G. C. Seymour, of Southwick, Sussex, who was a well-known model engineer, and a frequent exhibitor at the "M.E." Exhibition and other shows organised by societies on the south coast. Mr. Seymour was a very versatile craftsman, and equally at home in the production of small precision scale working models and experimental work on instruments and small i.c. engines. For several years, he had run an engineering and instrument-making business, and his pre-war productions included the "Kalper" miniature dial-test indicator, which was sold at a reasonable price, and has been used in many model engineering workshops; and since the war, he has devoted a good deal of attention to the production of small compression-ignition engines, the particular one being known as the "Foursome" engine.

Among Mr. Seymour's best-known models were the Austin scale model motor chassis, including a complete working four-cylinder engine and gearbox, which was exhibited at the 1947 "M.E." Exhibition and awarded a silver medal, and his scale model bicycle which was exhibited at the 1950 Exhibition, and awarded a bronze medal.

His death, at the age of 67, after only three days' illness, will be a great loss to the model-making fraternity generally, and particularly to his fellow club members, among whom he will be remembered as a kindly personality, always willing to help with advice or personal service in a good cause.

Famous Modeller on Television

● MR. REX HAYS, the well-known modeller of racing cars and author of *Racing Cars in Miniature* (Percival Marshall & Co. Ltd., 7s. 6d. net), will be doing a television broadcast from the South Bank Exhibition at 8.15 p.m., on Monday, June 11th. With him will be some of the models he built for the exhibition, and all who plan to read his book, or are in any way interested in this branch of highly detailed scale modelling are recommended to avail themselves of the opportunity of seeing and hearing Mr. Hays on the air.

The East Grinstead Exhibition
and Presentation to the Council
by Viola Barwell

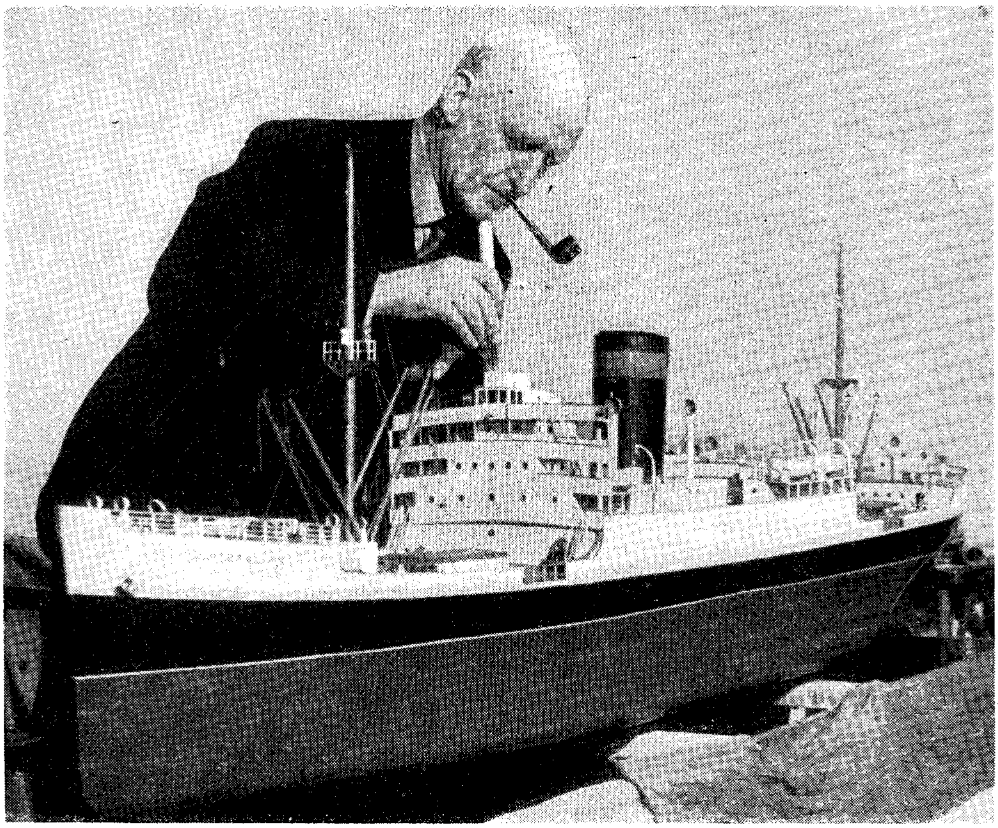


Photo by courtesy] [*Kent and Sussex Courier*

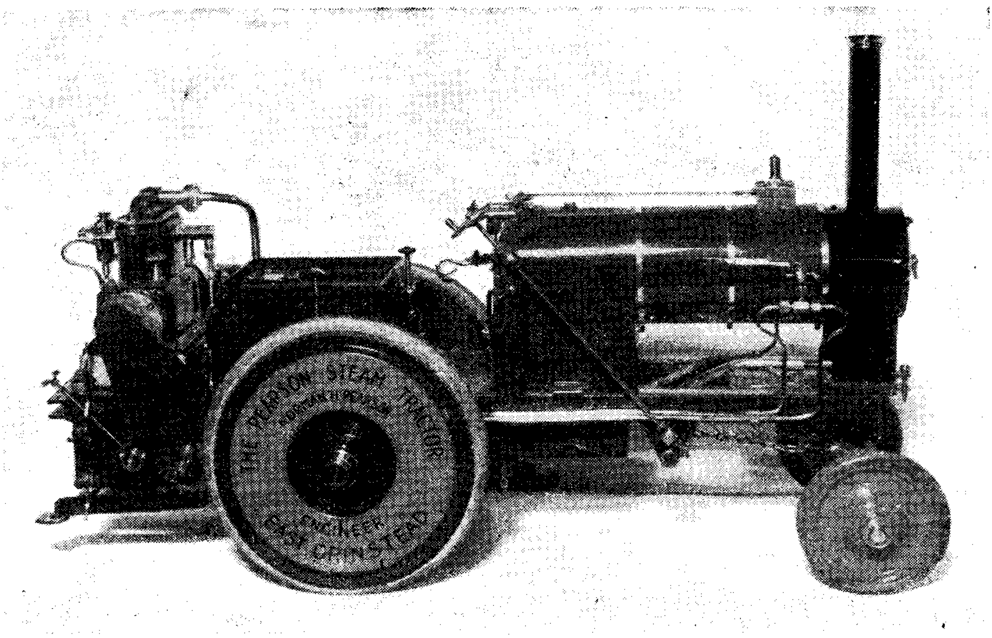
Mr. Millar and his radio-controlled liner

IN spite of everything the weather could offer—rain, snow, hail, and even thunder—the exhibition proved to be a magnet of sufficient power to draw some 2,098 people from their firesides during the 2½ days it was open.

There were, of course, special attractions. Prominent among these was the silver and blue enamel Badge of Office, which had been designed, made, and was now on show prior to being presented as a gift to the Urban District Council by the society. Alongside the table containing this and the awards was a model well worth, in one visitor's opinion "a day's journey to see." This was a radio-controlled scale model liner, 8 ft. long, and controlled by 24 impulses. The maker, Mr. Millar, of the Reigate and Redhill Society, an indefatigable lecturer, demonstrated what the liner would do, both in and out of the tank, and answered innumerable questions from the throng that was always pressed closely around him.

Another popular exhibit from a brother society was the model motor-cycle and sidecar shown and demonstrated by Mr. G. Wills, of the Chingford Society. As soon as the realistic pop of the exhaust was heard, enthusiastic and admiring visitors crowded round the exhibit. An additional thrill for the most interested was that, as Mr. Wills and his daughter had travelled down in the full-size original, they were able to go into the car park and see the real thing.

It was a constant source of pleasure and gratification to the executive committee to hear the exclamations of wonder, even incredulity, as the visitors crossed the threshold and beheld a panorama of some 250 models laid out before



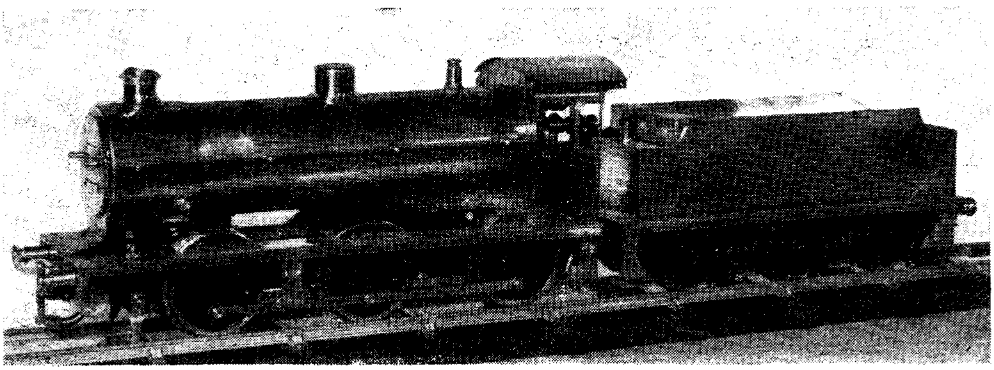
Mr. Pearson's passenger-hauling steam tractor

them, dominated by Mr. Lloyd's ten-rater yacht (with which he won the club cup) and covered by an " umbrella " of aircraft of all types.

Among the side shows was the " Home Workshop " laid out as in a small room with lathe, drilling machine, tools, etc. At intervals, members demonstrated the use of these, and one took the opportunity to machine a small part destined for the next exhibition. Next to this was a very popular innovation in the shape of a press bearing a placard " Make Your Own Ashtray." An inviting pile of attractively coloured aluminium blanks melted quickly away as all and sundry accepted the invitation to swing the handle. These ashtrays made a gratuitous advertisement, as outgoing visitors flourished them in the faces of their friends proudly crying, " All my own work ! "

One of the smaller rooms was occupied by another very attractive exhibit, a puppet theatre and puppets shown by Dr. Lucas, who, with a group of friends, gave two performances of a play written by himself, " Doris goes to the Circus," to the almost delirious delight of the crowds that pressed in to see them. Also, in this room, films were shown twice daily, providing a place to "rest your feet" at the same time.

It was a great disappointment to the society and visitors alike that we were not able to run either a locomotive or Mr. Pearson's passenger-carrying steam tractor. Unfortunately, the only available space had to be left clear as an approach to the emergency exit. However, consolation was at hand in the " O " gauge steam layout being run by Messrs. Chapman and Brealey. Such a small steam layout was a surprise to all, and many

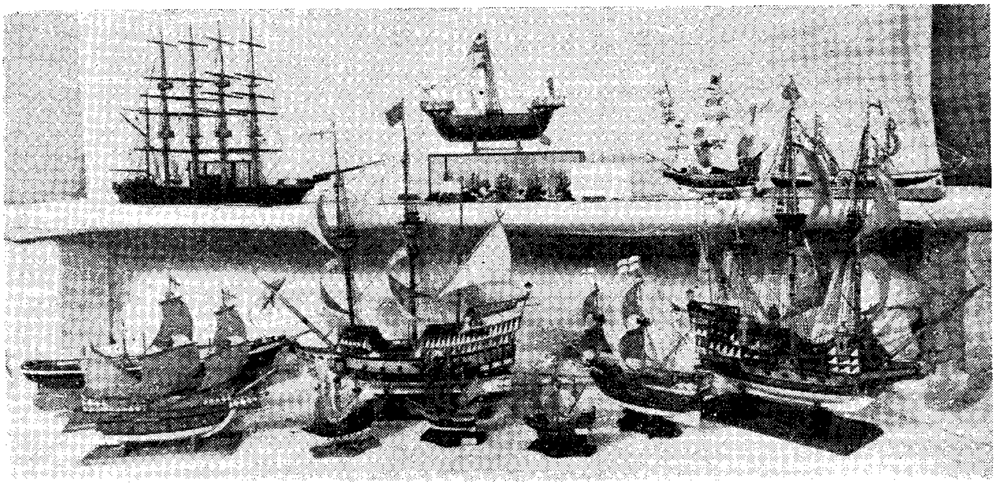


Mr. P. W. Chapman's " O " gauge locomotive

exclamations of admiration met Mr. Chapman's locomotives as they drew in and out of the station with amazing regularity.

Another permanent crowd hid the two rows of stationary engines working on compressed air, and some people were seen to be glued to this stand for several hours.

Rapturous feminine cries (as distinct from the merely polite interest shown elsewhere) were to be heard proceeding from the galleon section. Here were grouped some wonderful galleons by Mr. Edward Gosden, whose work in this field is already well known. Nearby were miniature ships of various types combining to make a striking and decorative display. Another source of gratification to the ladies was the display of beautiful plastic projects by Mr. Fraser.



The galleon section

Among the more unusual exhibits must be mentioned the anaesthetic apparatus designed and made by Mr. W. Barwell, and the crude home-made lathe which he produced from "junk" costing nothing, in order to make this machine. The apparatus has been in constant use over several years in the service of the medical friend for whom this was designed and made.

The crowning moment of the exhibition, of course, came on the Saturday evening, when many of the Urban District councillors were present to see their chairman, Mr. Arthur Perry, receive on their behalf, the silver Badge of Office. For some time before the hour fixed for the presentation, more and more people had been crowding in, and at a pre-arranged signal from the society's chairman and exhibition manager, Mr. H. Drewson, all the members formed a protective cordon around the stands, a very necessary precaution in view of the pressure of the crowd.

After the chairman of the Council had presented the competitors awards, there was an unexpected diversion. A wedding gift was presented from the officers and fellow-members of the society to a popular member and his bride; who had thought that their wedding, the day before, was still a very deep secret.

The president of the society then rose, and said that the provision of a Badge of Office had been mooted for some time within the Council. Costs, however, were found to be prohibitive and the matter was dropped until inspiration came to one of the councillors in touch with the society. The society was at once interested, and the badge, designed by the hon. secretary, was undertaken by the vice-chairman, Mr. W. Vice, who, with some help from another member, produced the finished article. (An illustration of this badge was published in the March 15th issue of THE MODEL ENGINEER.) Members raised the money for the silver by "taking in each others washing," in other words, jumble sales and the like. Therefore, from inception to execution, the badge was entirely the work of the society. Silver links, also to the hon. secretary's design, were being produced and were to be presented by various local organisations. After the badge had been hung round Mr. Perry's neck by the president, the chairman said that on behalf of the Council he thanked the society very much. He went on "We admire your public spirit. You have made history today, not only for yourselves, but for the town."

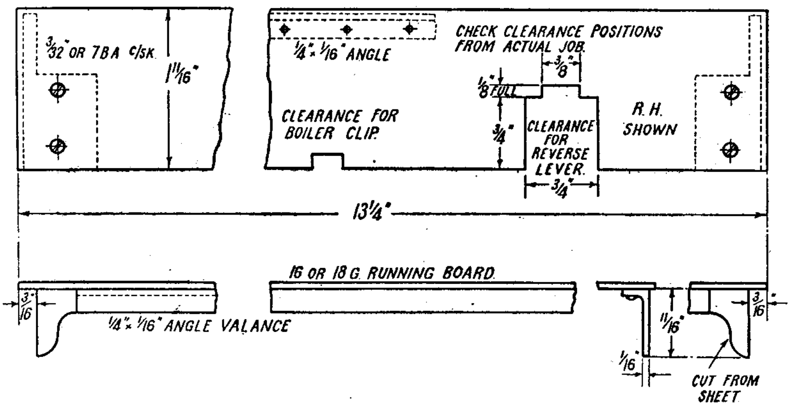
As a corollary, members of the society were present in the Council Chamber on the following Monday when the civic ceremony of investiture took place. This further presentation was made by the chairman of the society, Mr. H. Drewson, who, after a few well-chosen words, introduced the maker, Mr. Vice. Acknowledging applause from the assembled councillors, Mr. Vice astonished them by revealing that his only tools for this masterly piece of silversmithing were a fretsaw and two specially polished hammers. "Moreover," he said, "I did most of it on my kitchen table, as it was too cold to go into my little garden workshop."

In view of the fact that the society is not yet two years old, we feel that we have made our presence felt in the town in no uncertain manner.

"L.B.S.C.'s" Beginners' Corner

Running-Boards for "Tich"

FOR the running-boards, or side platforms as they are sometimes called, we shall need two strips of sheet metal, 16- or 18-gauge, $13\frac{1}{4}$ in. long and $1\frac{11}{16}$ in. wide. As long as the metal is nice and flat, it doesn't matter whether it is brass or steel; I prefer hard-rolled brass. Both edges must be perfectly parallel, and the ends truly square; if our approved advertisers don't supply the needful, ready sheared to width, a little judicious filing will be called for. Test the each end, and use $\frac{1}{16}$-in. brass rivets at about $\frac{1}{2}$ in. centres, countersinking the holes (No. 51 drill) on top of the running-board, hammering the rivets flush, and smoothing off with a file, so as to prevent an unbroken surface for the enginemen to walk on, same as we had on the L.B. & S.C. Railway engines. Alternatively, if you happen to be one of those good folk who would love to see a long row of pimples along the edge of the running-board, why, bless your heart



Running-board and valance

ends with a try-square. The right-hand running-board will require two "bites" taken out of it; one to clear the bracket supporting the reverse lever, with an additional clearance for the lever itself, and a small one to clear the clip holding down the expansion bracket on the boiler. A hole is also needed for the reverse arm to pass through. The left-hand one only requires the small clearance. The exact location of these bits to be cut out, is best obtained by measurements from the actual engine. The sides of the bigger one can be sawn down, a row of No. 40 holes drilled along the connecting line, the piece broken out with pliers, and the ragged edges trimmed to size with a file. The smaller clearances require filing only. When measuring for clearances, note that the running boards overhang the buffer beams by $\frac{1}{16}$ in. at each end.

Valances

The valances, as the edging below the running-board is usually called, are in three pieces; the central straight part is made from $\frac{1}{16}$ in. $\times$ $\frac{1}{4}$ in. angle, and the curved ends are made from sheet. Use brass angle if obtainable. The pieces of angle are approximately 12 in. long, and riveted to the underside of the running-boards at $\frac{1}{16}$ in. from the edge, leaving $\frac{5}{8}$ in. at front and back. Clamp in place with a toolmaker's cramp at

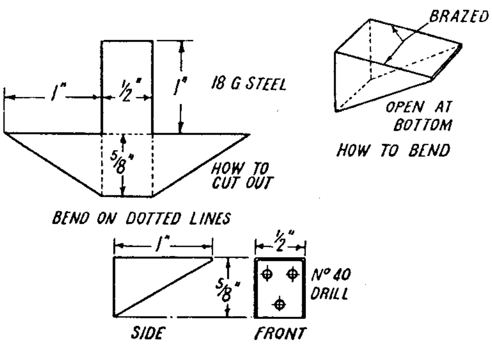
and soul, go right ahead and enjoy yourself. Space the rivets about $\frac{3}{16}$ in. apart, put them in from the top, and rest the head on a dolly held in the bench vice. This is just a bit of round or square steel rod, about $\frac{1}{4}$ in. diameter, with the end truly squared off, and a recess for the rivet-head formed in it. Just make a countersink with a 5/32-in. drill, put a 5/32-in. cycle ball in the countersink, and give it two or three hearty biffs with a heavy hammer. This will turn the countersink into a cup recess, about the right size for a $\frac{1}{16}$-in. rivet head. Rest the head in this, and you can then hammer down the projecting stem of the rivet inside the valance, without destroying the pristine beauty of its noddle. Final tip—for goodness sake keep the line of rivet-heads dead straight; if any are out of line, the net result is what the kiddies would call "worse 'n awful."

The end pieces which curve down to the buffer beams, will need four pieces of 16- or 18-gauge sheet metal, each 1 in. long and $\frac{7}{16}$ in. wide. Mark them out as shown in the illustration, leaving a tag $\frac{5}{16}$ in. wide above the curved outline. Bend this at right-angles, and don't forget you need two right-hand and two left-hand; then rivet them to the underside of the running-board, so that they match up with the angle section, and in effect, form a continuation of it. To keep them in line, I usually solder a little

strip of metal, about $\frac{1}{2}$ in. long and $\frac{3}{16}$ in. wide, on the inside, half on the angle and half on the end-piece. If the crack, or join, between the two, is filled up with solder—it usually fills "on its own" without any help!—and filed off flush, the joint is invisible when the valance is painted.

How to Erect the Running-boards

On the plan view, you will notice the outline of the tops of the buffer beams shown dotted, and two screwheads are shown at each end. They are $\frac{3}{8}$ in. from the ends of the running-boards, and approximately $\frac{5}{8}$ in. apart; the exact spacing doesn't matter a Continental. Drill the two No. 41 holes at each end, and countersink them. Put the running-board in position, and carefully adjust it to get the proper amount of overhang at each end. The inner edge should be level with the top edge of the frame. Poke the No. 41 drill through the holes, and make countersinks on the beam tops; hold the running-board in place with a toolmaker's cramp at each end, whilst this is being done. Drill out the countersinks with No. 48 drill, tap the holes 3/32 in. or 7 B.A., and put countersunk screws in. Now put the reverse lever in full forward gear, and take a look at the lifting arms on the weighbar shaft. If your workmanship is true to measurements, the ends should just clear the underside of the running-board by about 1/64 in., which is quite O.K. If, however, there should have been any slight error, and they touch, there is nothing to worry about. Just mark the point of contact, and make a clearance by taking off the running-board, drilling a hole about $\frac{3}{16}$ in. diameter at the marked spot, and filing it out with a small square file until the lifting arms will clear easily.

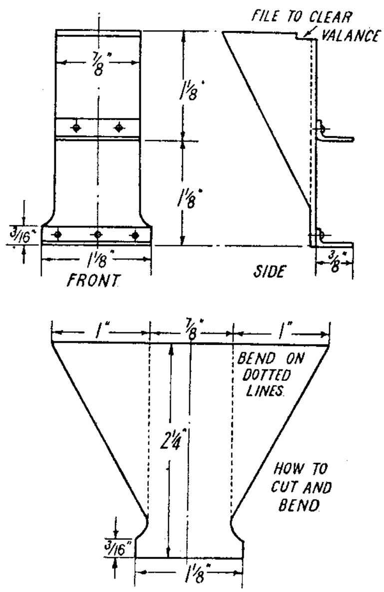


Sheet metal bracket

There may be a slight gap at the top of the guide-bar bracket, where the running-board passes over it. If so, cut a piece of sheet metal about $\frac{1}{2}$ in. square, and just thick enough to push in between the top of the bracket and the underside of the running-board. If this is simply soldered to the underside of the running-board, it will prevent any tendency to sag.

An extra support will be needed between the guide-bar bracket and the back buffer beam, and this is provided by a bracket which can be either cast, or bent-up from sheet metal. Fabrication is used now, to a great extent, in full-size practice, so we may as well follow suit; a fabricated bracket is very strong and light. The illustrations show how to cut out the bracket from 18-gauge steel; a wee bit thicker or thinner metal doesn't matter in the present instance. Mark out as given, cut to shape, and when bent on the dotted lines, you'll have a sort of triangular box, the joints of which are brazed in a matter of a couple of minutes. Apply wet flux (Boron compo paste), blow up to bright red, touch the joints with a bit of soft brass wire, and Bob's your uncle once again. Drill three No. 40 holes in the back of the bracket as shown; set it in place under the running-board about midway between the guide-bar bracket and the back buffer beam, with the drilled part butting up against the frame, and the top part tight up against the underside of the running-board. Attach to frame with three 3/32-in. or 7-B.A. screws, any head available will do; you'll know how to locate drill, and tap screwholes by now! Then drill one solitary No. 40 hole right through the running-board and the top of the bracket; countersink it, put in a countersunk screw (3/32 in. or 7 B.A.) and secure it with a nut underneath. The running-boards should now be perfectly rigid.

The space between the boiler backhead, the two running-boards, and the back of the buffer-beam, can now be filled in by a piece of the same kind of metal as used for the running-boards.

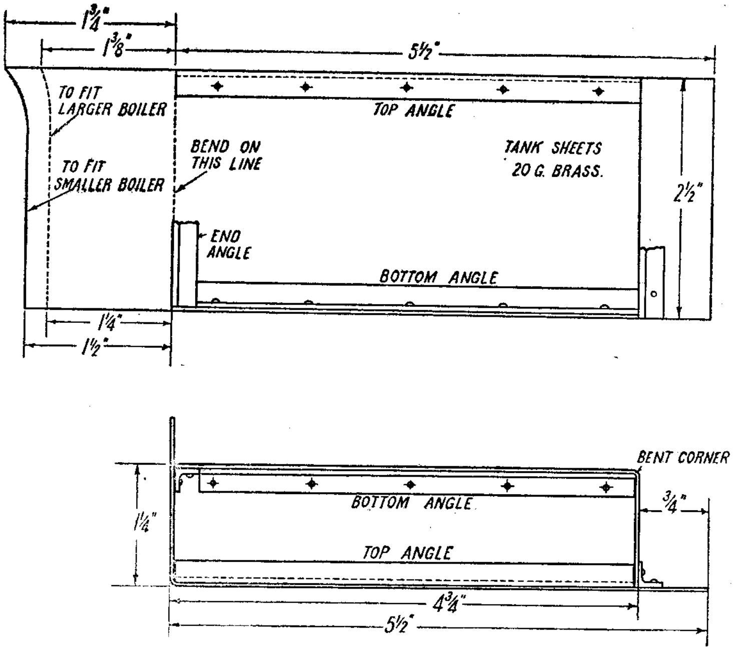


Details of sheet metal steps

The size of this is obtained from the actual engine, so no drawing of it is needed. Nicks are filed in the edge next the boiler backhead, to form clearances for the pipes, when all the pipe work is completed. It can be fixed to the top of the back buffer-beam by a couple of screws, same as the running-boards; metal of 16 or 18 gauge should be stiff enough to "stay put"

without further support at the front end, as it has not the weight of a driver and fireman to carry. If it shows any tendency to sag down, just attach a short bit of angle to the boiler backhead, or to the frame at each side, doesn't matter which, as long as it holds up the bit of footplate. No drawing is needed for that simple job, either, as our beginner friends should " know their A.B.C." by now, in a manner of speaking! have something bigger to catch hold of, and probably get a hearty pat on the back from Inspector Meticulous in the bargain!

The steps are made from 16- or 18-gauge sheet metal, in a manner somewhat similar to the brackets for the running-boards; the illustration clearly shows how they are cut out and bent to shape, without further explanation. The treads are bent up from sheet metal also, and may be either riveted or brazed on. They are not fixed to the running-boards until the tanks and bunker are erected, so as to get them exactly in the space between; see general arrangement drawings.



Details of side tanks

A similar piece of metal is needed to fill the space in front of the smokebox, and the measurement of this, also, is obtained from the actual engine; but this differs, inasmuch as it must be made detachable, for the purpose of filling the mechanical lubricator. This is easily done. Drill two holes in it, just as if you were going to screw it down to the front buffer beam, but use No. 48 drill. Put the piece of metal in place, and make countersinks on the top of the buffer-beam; then remove the metal, and drill the holes in the beam, through the countersinks, with No. 40 drill. Instead of screws, cut two bits of 3/32-in. round wire about $\frac{1}{4}$ in. long: chuck in three-jaw, and turn a full $\frac{1}{16}$ in. of the end, to fit tightly in the No. 48 holes in the plate. Put them in, and rivet the ends over. When the plate is dropped into position, the little pegs will go through the holes in the beam, and prevent the plate slipping forward; it can't sag down towards the smokebox, as the filler of the mechanical lubricator will hold it up. A lamp iron, made from 18-gauge brass or steel, and set in the centre of the front edge, will serve as a lifting handle; or better still, permanently fit a dummy lamp in the same position, and you'll

Side Tanks

The tanks form a nobby exercise in neat platework; nice flat smooth sides and properly squared ends, are called for, if the little engine is to look like a real good job. The outside sheet, and the front end, are in one piece; the inside sheet and the back end are also in one piece, both being put together by aid of angles, as shown in the illustrations. For the small-boilered engine, the outside sheet needs a piece of 20-gauge sheet brass $7\frac{1}{4}$ in. long and $2\frac{1}{2}$ in. wide; for the larger boiler it is $\frac{3}{8}$ in. shorter. For the inside sheets of both, the necessary piece is 6 in. $\times$ $2\frac{1}{2}$ in. The easiest way of ensuring that the front end fits the curve of the boiler, is to make a template from a piece of stiff paper or thin cardboard; this can easily be cut to shape by aid of the domestic scissors, and if you spoil a dozen pieces before getting it O.K. you won't be a farthing the poorer—but sheet metal is both scarce and expensive! When you get it right,

lay the cardboard on the metal, run your scriber around the edge, and carefully cut to outline. Then mark off the bending line as shown, and bend to a right-angle in the bench vice. It looks better if the corner is slightly rounded. Don't on any account hit the metal with a hammer; hold a piece of wood against it, and hit that. The inside sheet is also bent at right-angles, at $1\frac{1}{4}$ in. from the end. The two pieces are then placed together, as shown in the plan view, and a piece of $\frac{1}{4}$-in. $\times$ $\frac{1}{16}$-in. angle, or a bit of home-made angle bent up from sheet, is riveted into each corner. Be very careful to have a true rectangle. The reason for the actual tank being shorter than the outside sheet, is to allow space for the reverse lever, and the bypass fittings. Again, may I remind our worthy friends that one right-hand and one left-hand tank is needed.

Stand the embryo tank on a piece of 16- or 18-gauge sheet brass, and run your scriber all around the inside at the bottom; then cut out the marked piece, so that it fits tightly into the bottom of the tank, lying flush with the edges. Cut two pieces of angle, to fit along the bottom of each tank, and two to fit along the top edge, as shown. These can be temporarily tacked with solder, whilst the holes for the rivets are drilled No. 51, and $\frac{1}{16}$-in. brass or copper rivets put in. Countersink the rivet holes underneath the tank, hammer the rivets flush, and smooth with a file, as the tanks have to sit down tightly on the running-board. Here again, lovers of millions of rivet heads can let themselves go once more, by close-riveting the top and bottom angles, and letting the heads show on the outside of the tanks; but I personally prefer to see them perfectly smooth. The upper angles are flush with the upper edges of the tanks, as the tank covers have to be screwed down to them. When all the angles are fixed, sweat over all the joints, on the inside of the tanks, with soft solder, same as stayheads, etc., to make the tanks perfectly watertight. Next stage, fitting in the hand pump, and the bypass connections and valve.

A GAS LIGHTER

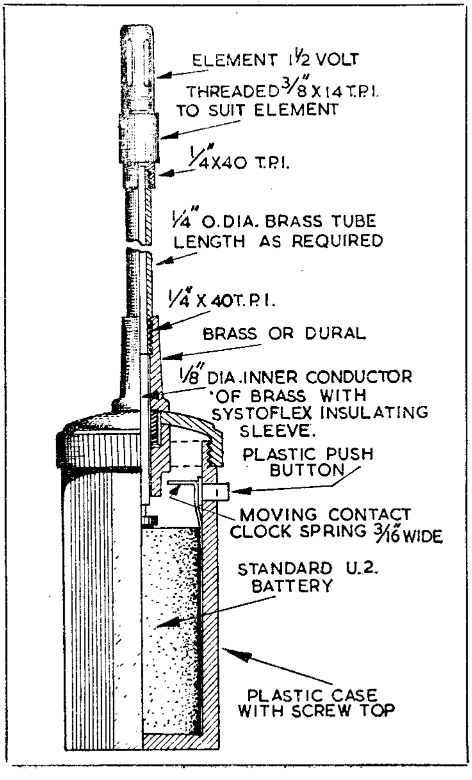
by A.C.E.

THE basis of the useful gas lighter described below is the plastic screw-top case provided for their product by the manufacturers of a shaving soap. It will be seen from the sketch that the case is precisely the size needed to accommodate a standard U.2 battery. As the sketch is largely self-explanatory, it is not proposed to give a detailed description, but the following points should be noticed :—

1. The length of the inner conductor and systoflex sleeve should be so adjusted, that when the element is screwed into the holder the conductor is just nipped between the centre contact of the element and the positive cap of the battery.

2. The underside of the exterior tube holder, which is in contact with the screwed cap of the plastic container, should be machined slightly concave to correspond with the top of the cap. The opposite will apply to the interior portion, which should be made slightly convex.

This will ensure a tight grip and avoid any tendency for the two portions to become unscrewed.



3. The contact spring must be inserted between the wall of the battery, and the covering outer cardboard sleeve, and the spring then bent to obtain a clearance of approximately 1/32 in. from the wall of the inner nut. The best clearance can only be found by experiment.

4. To prevent the battery twisting in the case and so disengaging the contact strip from the push-button, it may be necessary to insert paper packing between the battery, and the outer case; if this has to be done, it is advisable to drill a $\frac{3}{16}$-in. hole in the bottom of the case so as to enable the battery to be pushed out for the purpose of replacement.

In conclusion, I would say that the lighter in my possession has been in constant use for over five months, and the original battery is still giving good service. The only items purchased were the element 9d., and the battery 5d., the remainder being salved from the junk box.

THE S.E. ASSOCIATION REGATTA

THE opening regatta of the 1951 season was held recently at Brockwell Park, London, S.E. Organised by the South Eastern Association, this regatta attracted a remarkably good attendance, and also marked the appearance of several new boats and some new competitors.

An astonishing feature was the fact that the winning speed in three of the speed events was identical—51.2 m.p.h. Perhaps a pointer to the fact that speed is largely a matter to power/weight ratio, irrespective of the size of the engine.

The speed events were first on the programme due to local restrictions regarding the times of running of the noisier boats, and the regatta opened with a 300 yd. race for Class "D" boats.

Now, it is known that, although the official record for this class is still below 40 m.p.h., boats of this small size (5 c.c.) have exceeded 50 m.p.h. unofficially when perfect conditions are present. However, 99 per cent. of regattas run in this country are blessed with anything but ideal conditions, and although the weather was reasonable, it was no surprise that many competitors failed to return a time.

The best times were recorded by members of the Enfield Club: Mr. Everett with *Jaffa* returning 15 sec. for the 3 laps, followed closely by Mr. Woodley with *Pry* and Mr. Shepherd with *Edi.* Mr. Petch (Bromley) also made a clean run with *Moya,* a boat new to regattas.

Second on the programme was a 500 yd. Class "C" event and provided a lot of interest, as both R. Phillips (S. London) and E. Clarke (Victoria) were entering new boats. Both of these craft proved fast, and *Foz II* was a worthy successor to *Foz* by winning the race at 51.2 m.p.h. Mr. Clarke's boat *Anne,* however, is very fast and only showed her best performance after completing the timed laps. The speed for the timed distance was 40.6 m.p.h., and this took second place. Of the other competitors, only J. Benson's *Moth* (Blackheath) finished the course.

"No Race" was the result of the 500 yd. "C" Restricted Race, since none of the boats completed the necessary five laps. The record holder *Lady Babs II* owned by G. Stone (Kingsmere) did some aerobatics on a second run after stalling on the initial attempt.

The 500 yd. Class "B" race proved a walk-over" for G. Lines (Orpington) with *Sparky II,* the best run was 51.2 m.p.h. and the only other competitor in this race, N. Hodges (Orpington), failed to get away on any of the permitted attempts with *Sparta II.*

The last of the speed events was a 500 yd. Class "A" race and six boats competed in this. A. Cockman (Victoria) with *Ifit* 6 made a fine run at 51.2 m.p.h., but unfortunately fractured a valve link just on the finishing line. E. Clarke (Victoria) with *Gordon* 2 also recorded 51.2 m.p.h. which made a tie for first place, on a re-run *Ifit* 6 was unable to run, so *Gordon* 2 again recorded 20 sec. for the distance—51.2 again!—this effort made E. Clarke the winner. I. Innocent (Victoria) with *Betty* made two good runs, but not up to best speed, and J. Ward (Orpington) with a new boat fitted with fearsome-looking twin propellers failed to get a proper run. B. Miles (Kingsmere) with *Barracuda* recorded about 40 m.p.h., well below the usual performance of this boat.

After the lunch interval the programme continued with the straight-running events. First a Nomination Race over 65 yd. and some 20 boats took part in this.

Considering that this was the first regatta of the season, the boats were well on form. Two competitors J. Thomas (Blackheath) with *Rose* and F. Curtis (Kingsmere) with *Korongo* both returned exact nominations, and it was decided that these two craft should re-run the same course keeping the original nominated times. This time J. Thomas was one second out while F. Curtis was two seconds in error.

The Steering Competition followed immediately; the same boats taking part and the distance 65 yd. remaining the same. There was some keen competition in this contest, the result being in doubt for quite some time. F. Curtis with *Korongo* managed to score 13 pts. and this was the winning total, the next best being 11 pts. by A. Clay (Blackheath) with *Elizabeth.* J. Benson (Blackheath) was third with 10 pts., and Messrs. Walker (Kingsmere) and Hood (Swindon) scored 9 pts.

Only a few boats failed to make a score of some sort, and some close contests are forecast this year among the steering boats!

Results

300 *yd. Class "D" Race*

1. Mr. Everett (Enfield), *Jaffa*: 15 sec., 40.9 m.p.h.
2. Mr. Woodley (Enfield), *Pry*: 16.25 sec., 37.8 m.p.h.

500 *yd. Class "C" Race*

1. R. Phillips (S. London), *Foz II*: 20 sec., 51.2 m.p.h.
2. E. Clarke (Victoria), *Anne*: 25.2 sec., 40.6 m.p.h.

500 *yd. Class "C" Restricted Race*

None finished.

500 *yd. Class "B" Race*

1. G. Lines (Orpington), *Sparky II*: 20 sec., 51.2 m.p.h.

500 *yd. Class "A" Race*

1. E. Clarke (Victoria), *Gordon* 2: 20 sec., 51.2 m.p.h.
2. A. Cockman (Victoria), *Ifit* 6: 20 sec., 51.2 m.p.h. Final placings after re-run.

Nomination Event

1. J. Thomas (Blackheath), *Rose*: nom. 11 sec.; actual 11, 12 sec.
2. F. Curtis (Kingsmere), *Korongo*: nom. 16 sec.; actual 16, 18 sec.

Steering Competition

1. F. Curtis (Kingsmere), *Korongo*: 13 pts.
2. A. Clay (Blackheath), *Eliazbeth*: 11 pts.
3. J. Benson (Blackheath), *Comet*: 10 pts.

Flexible Shaft Equipment

and Construction of a Drilling Hand-Piece

by Robert Cutler

AN article by J. W. Tomlinson on this subject (" M.E.," March 11th, 1947, page 275) gives an excellent idea of proprietary flexible shaft equipment and accessories suitable for use with it, and, as described, it is seen to be a fine engineer's tool, well meriting a place in the fitter's shop. The model therein illustrated is, however, dentist's drilling hand-piece is used, the difference can at once be understood. To achieve this delicacy of application the proportions of the dentist's hand-piece are carefully gauged, the overall dimensions being surprisingly critical, so delicate is the balance and muscle control of the fine craftsman's hand.

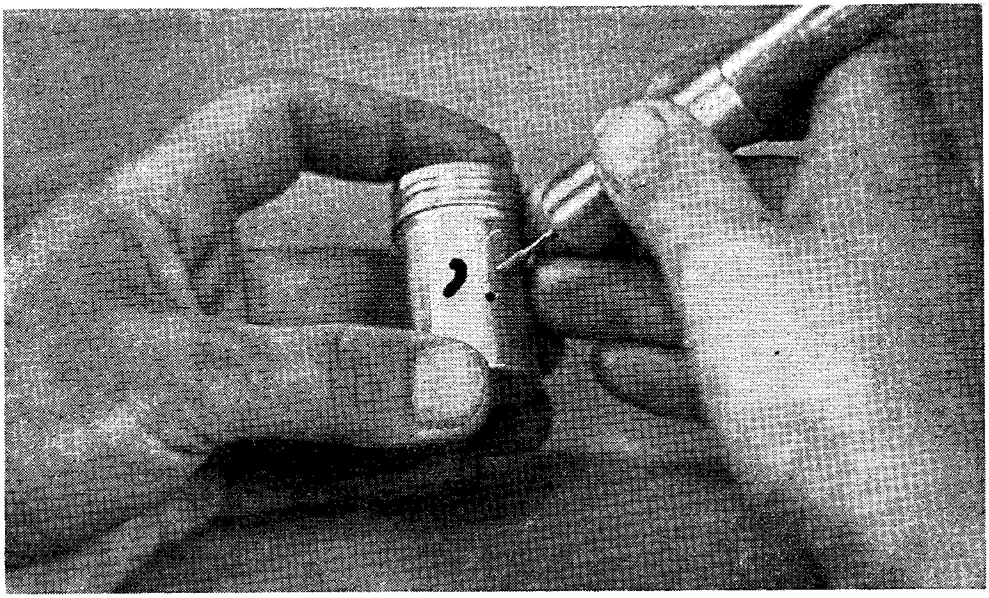


Fig. 1. Drilling hand-piece held in the pen grip position, stabilised by the third and fourth fingers resting on the work-piece. Fissure type dental drill in hand-piece, showing circular and profiled holes drilled in thin aluminium container

still far too big for many delicate model engineering jobs, and it is the purpose of this contribution to consider design and construction of drives and accessories of a smaller nature, somewhat akin to the drive shaft and hand-piece used by the dental surgeon. A study of the latter's equipment will be useful, some of the details and accessories being incorporated in the layout to be described, which will handle drill capacities up to $\pm \frac{1}{8}$ in. and grinding wheels up to $\pm \frac{3}{4}$ in. diameter. In all—or most—commercial models the chuck extends well beyond the hand-piece itself, which is usually of large diameter, so that the operator has to hold the body of the hand-piece with an overlapping grip, similar to one's grip on the handle of a garden roller: such a grip, whilst essential for heavy buffing, fettling, or grinding, does not allow any real delicacy of application, and if one compares this grip with the " pen grip " position in which the

For the dentist, controlled free hand drilling of minute sensitive areas of the teeth is pure everyday routine, and a study of Fig. 1 shows how the whole hand is stabilised by the two fingers, or thumb, resting on the work-piece, this both steadying the drill and preventing slipping of the whole hand itself. Every model engineer must recall difficulty in setting-out, and drilling or profiling holes in, say, very thin gauge tubing, but when using a suitably designed drilling hand-piece in pen grip fashion with the hand " on guard," it is simplicity itself, and Fig. 1 shows how a dentist would instinctively perform such an operation, if he was given the drilling hand-piece to be later described. From the foregoing it is at once clear that the thumb and first two fingers have to be reasonably close to the drill head, so that any form of long or bulky chuck is quite unsuited for " pen grip " application, whilst the body of the hand-piece must not be

over long or large in diameter, 5 in. length and ⅝ in. diameter being near the permissible maximum for the average hand. The dentist's hand-piece (Fig. 2, bottom) fulfils all these desiderata and is further specialised for easy unchucking, but is by no means free from friction, as evidenced by heating if used for heavy duty drill work outside the mouth. It is, however, precision made with a long vibration-free working life, this also applying to the flexible shaft drive to which

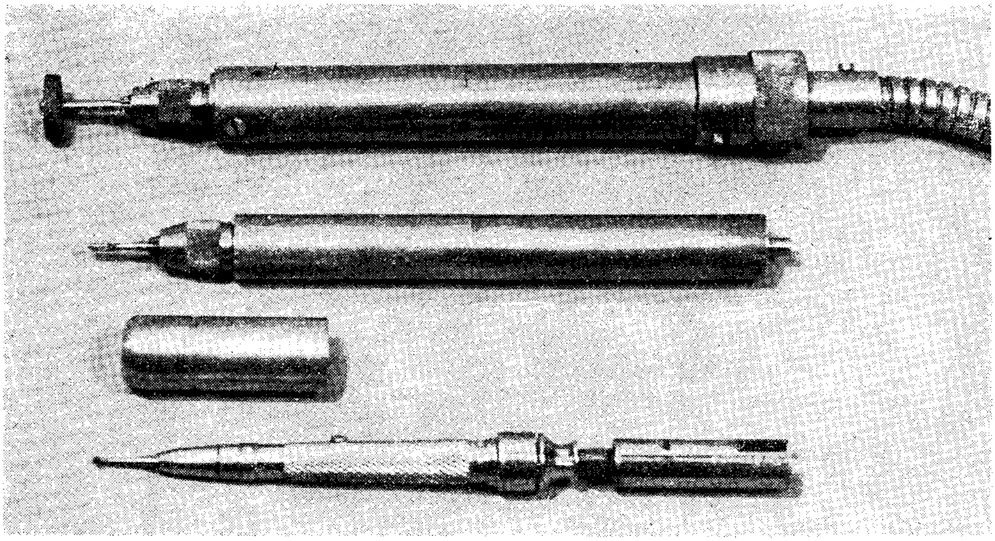


Fig. 2. Above—Heavy duty hand-piece with bayonet cap attachment to Aero-spares flexible shaft. Tommy bar hole shown for locking spindle when tightening chuck. One-piece casing with heavy thrust race and detachable main bearing bush. Centre—Model described in text with chuck cover hood below. Tommy bar hole and stud for locking hood not shown. Below—Dentist's hand-piece, showing automatic chucking of drill by pulling knurled section of body forwards from shaft slip-joint connection

it is fitted, the cost of this assembly alone being about £10. The flexible shaft arrangement, similar to the engineer's shaft, is now less commonly used by the dentist in the surgery (though still standardised for his laboratory technicians), all cord drive on articulated arms with idler pulleys at the knuckle joints being modern practice, as this drive provides adequate power and is very smooth and silent : now, quite apart from the fact that few model engineers would wish to spend the amount indicated on such a layout, the dental hand-piece itself is not entirely suited for the relatively heavier work he will undertake, and the hand-piece to be later described, made from freely available material, will prove little less convenient, and in all other respects more suitable, the total cost not exceeding 10s., some war surplus flexible drives being quite suitable for linking to it. It should again be emphasised that dimensions for " pen grip " application are fairly critical, and readers contemplating construction are advised to adhere to the layout suggested. Smaller plain bearing models could be constructed and a larger heavy duty model is also useful, this being shown in Fig. 2, top, with bayonet cap attachment to an " Aero-spares " ball thrust shaft.

Motor and Shaft Assemblies

A. Motors. Some form of constant speed motor with an r.p.m. range of 2,000-3,000 is very desirable, as a.c.-d.c. units of " fan motor " type are very tiresome, in that the torque is poor, and the motor races under " light " or " no load " conditions : an example of a virtually ideal motor for small work is the " Fracmo " frame 250 a.c. capacitor motor, 1/30 h.p., 2,800 r.p.m., this having a ball-bearing double-ended shaft, the unused shaft end being useful for a 2 in. diameter grinding wheel. A converted war surplus rotary convertor of ¼ nominal h.p. with a single end shaft and constant speed of 2,000 r.p.m. approx. has also been adapted very satisfactorily for this purpose. If the motor has a single-ended shaft, it should, of course, be wired to run anti-clockwise, reversal of rotation being usually easy to arrange, if incorrect when purchased.

A foot switch is also highly desirable if not essential, as it leaves both hands free, such a switch can be easily made, though war surplus plunger switches can be obtained and adapted (Fig. 3). The motor can rest on the bench in a cradle or trunnion, but is most conveniently hung shaft downward on the wall so that the hand-piece is at bench level, this economises space and prevents undue flexing of the shaft drive ; a foot switch being particularly helpful with this layout (Fig. 4).

B. Flexible Drives. One of the hand-piece models mentioned has been arranged for use with the flexible shaft offered by Aero-Spares, but many forms of flexible cable are permissible, such as speedometer or tachometer drives : as regards these latter, the inner driving cable should be carefully inspected, as many are

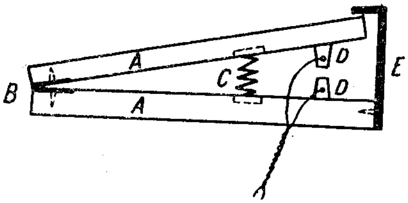


Fig. 3.—Motor foot switch. " A.A." wood battens, 1 ft. by $\frac{3}{4}$ in. thick by 4 in. wide, hinged at " B." " C "—motor-cycle type valve-spring in recessed seating. " D "—brass electrodes. " E "—vertical iron strip as limit stop

essentially slow speed shafts and may unwind and seize under heavy load. Most good cables are double wound with a central hollow core in which the terminal engaging dogs are soldered. Second-hand dental shafts are useful, the parts being standardised and replaceable, and information regarding new shafts of this type is easily available. The outer cable, usually armoured, should be an easy fit and is usually reinforced at the ends where maximum flexing would otherwise occur. The outer cable may contain bearings at both ends, or at least at one, and it is important that the inner driving shaft should not be fixed rigidly to both hand-piece and motor; i.e., one end should incorporate a sliding dog form of engagement to prevent endwise strain under any condition of shaft movement.

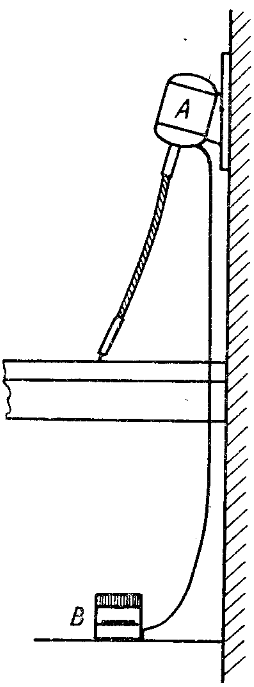


Fig. 4.—Wall mounting of motor (" A ") with hand-piece at bench top level, and position of foot switch (" B ")

C. Attachment of Drive to Motor. Usually the end cover plates of the motor are secured by cap-nuts or studs screwed into the main body, these latter being centralised to the main shaft, so that end-pieces of thick rod can be drilled and tapped to replace the cap-nuts, a cross-bar of substantial size being screwed to the ends of the extension-pieces: this can be drilled so that the aperture is co-axial with the main shaft, and the outer flexible cable secured by appropriate means (Fig. 5). The sliding dog for the inner shaft is best arranged at this end, and this can be of many forms, one of which is illustrated (Fig. 6). Pulley drive from motor to shaft, can also be arranged, provided the shaft has a proper spindle bearing at the motor end; this arrangement gives a

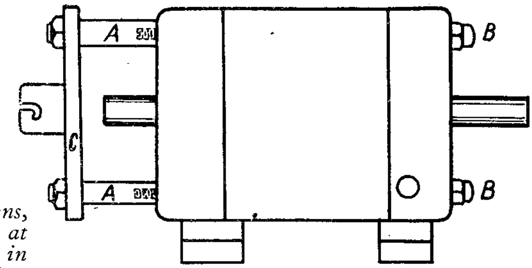


Fig. 5. Extension fitting for shaft. " A.A." extension-pieces fitted instead of cap nuts " B.B." Cross-bar " C " for attachment of outer casing.

maximum length of flexible shaft for any given overall length, and allows speed variations if small multi-groove pulleys are employed. A vacuum cleaner type of endless rubber belt provides the best drive, this obviating any need for a tension device between the spindle, the flexible shaft spindle being arranged in a cradle attached to the

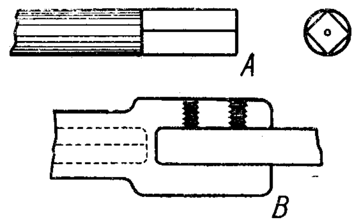


Fig. 6.—Sliding dog arrangement for driving shaft. (" A ") shows squared section of the shaft terminal driving spigot. (" B ") shows sleeve secured by set-screws to motor shaft, with open end profiled to a square section internally

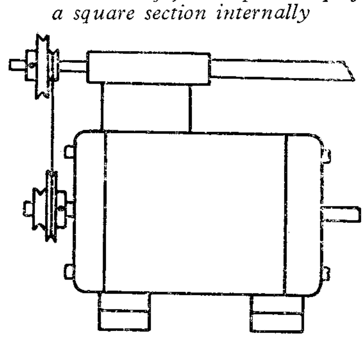


Fig. 7. Multi-speed pulley drive arrangement with reversed shaft.

main casing of the motor (Fig. 7). The hand-piece end of the shaft can have a bayonet cap attachment or can have a set-screw and sleeve arrangement, but it should be as light and as neat as possible to avoid upsetting the balance of the hand-piece when held in the manner suggested. Underpowered motors and light flimsy drive cables are to be avoided at all costs if the construction of a tool for serious and continued use is contemplated, otherwise there will be constant trouble with seized and broken shafts and inaccuracy due to irregular torque.

(To be continued)

PETROL ENGINE TOPICS

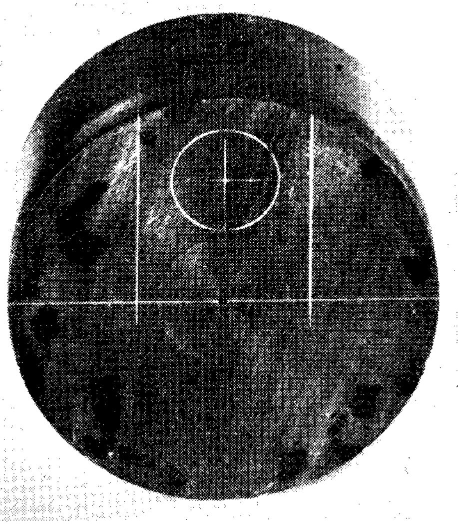
*A 50-c.c. Auxiliary Engine

by Edgar T. Westbury

IT will be noted that in the detail drawing of the piston, the dimensions of the piston ring grooves are not specified, and just in case this may give rise to a flood of queries, I will explain that the reason for this is that it will probably be necessary to use whatever rings may be available for the particular bore diameter. The width of ring originally specified was 3/32 in., but I am informed that this width is difficult to obtain at present, and ⅛-in. rings are more readily available. It will make very little difference to the engine performance which of these is used; narrow rings exert a higher pressure on the cylinder walls and tend to bed down quicker, while their weight (and, therefore, inertia) is less, but the wider rings, which were the more usual practice a few years ago, give excellent results and are, if anything, more durable—provided in either case that, the cylinder bore is accurate and well finished.

In this, as in many other things nowadays, a policy of "making do" may be necessary, in view of the shortage both of raw materials and manufactured components. Even in manufacturing industries, it is not always possible to obtain the material specified, and the practicability of utilising substitutes must be given serious consideration.

Some constructors may wish to make their own piston rings, but although this is by no means impossible, I do not think the facilities of the average home workshop are suitable for this specialised work. Manufacturers of piston rings in large quantities employ materials, processes and equipment not generally available to the amateur. I have on several occasions made piston rings for my own engines, but I do not consider them equal in quality to the Wellworthy rings which I usually recommend. The most suitable material for piston rings, should readers wish to try making them, is very fine-grained cast-iron; any metal which is ductile, or liable to take a permanent bend after machining, is definitely unsuitable.



Crank disc marked out to show position of crank-pin and outline of web

Gudgeon-pin

This should, preferably, be made of mild-steel, and case-hardened. Silver-steel, in the "untreated" condition, is often used by amateurs for this purpose, but although not really hard enough to wear well, is liable to be somewhat brittle, and if hardened and tempered, is much worse in the latter respect. Open-hearth or "cyanide" hardening of mild-steel, or better still, "box" hardening, provides a combination of dead hard wearing surface and soft core, which is most suitable for the duty called for in this component. The technique of case-hardening is dealt with in "Novices' Corner" in this issue. After case-hardening, the surface of the pin should be highly polished.

It will probably be found necessary, or at least desirable, to machine the gudgeon-pin all over from steel bar larger than ⅜ in. diameter, as it must be a good fit both in the piston bosses and the little-end eye of the connecting-rod when finished. A very slight taper—about 0.0005 in. in the length—is permissible so that the pin may be inserted in the piston easily for about three-quarters of its length, and tapped in for the rest of the way. Too tight a fit of the pin in the piston is liable to cause distortion of the latter in inserting or removing it.

The end pads may be made of brass, soft bronze, or duralumin, and should be a light press fit in the bore. Their purpose, of course, is to prevent the risk of the pin moving endwise and scoring the cylinder bore, and while there are other methods employed in common practice for this purpose, this is the simplest I know of in the present circumstances.

Crankshaft

The somewhat unusual form of crankshaft construction which has been adopted in this engine is intended to economise both metal and machining time, in view of the fact that it is

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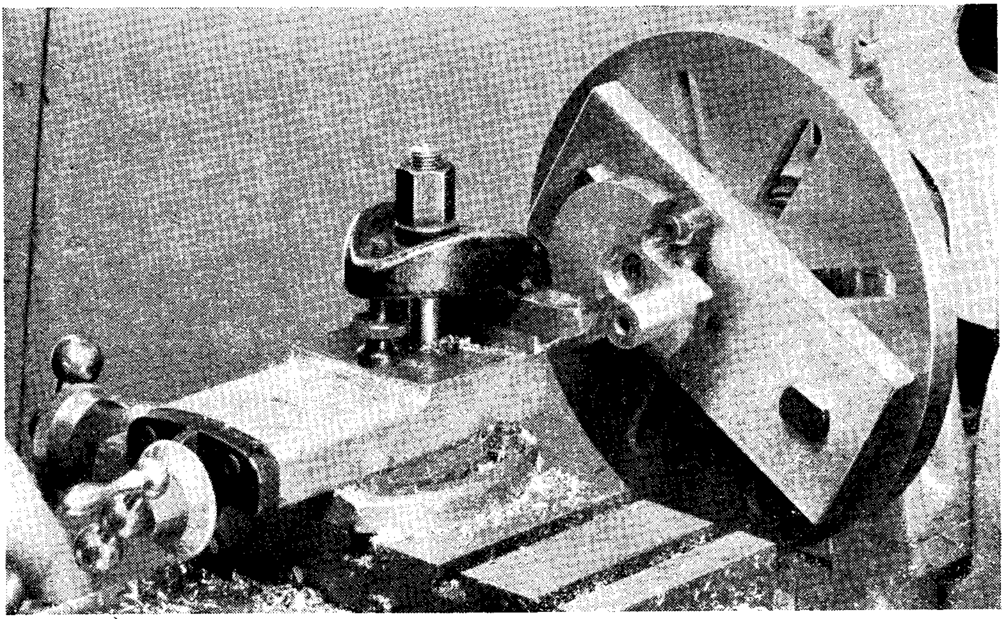
*Continued from page 674, "M.E.," May 24, 1951.

hardly practicable to obtain a suitable forging. It will be seen that the main journal portion of the shaft is of somewhat abnormal length, as compared with that of the usual small two-stroke, and, therefore, the machining of the complete crankshaft from solid would call for a billet of steel 2½ in. diameter by 8 in. long, most of which would have to be machined away, and this would be both a wasteful and a tedious process.

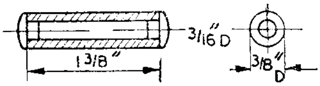


Crank disc mounted on a throw-plate for eccentric-turning operations

The two-piece construction shown enables a short piece of large diameter material to be used to form the web, balance weight and crankpin, and a longer piece of small diameter material for the journal ; it has the further advantage that different grades of material, to suit the respective duties of the two portions, may be used if desired. I have employed this form of construction with success on earlier engines, notably the *Atom I*, and have no doubts as to its structural strength ; as a matter of fact, three "Busy Bee" engines have been built with the form of shaft shown, and have so far shown no signs of disintegration under running tests. The joint by which the two parts are connected needs to be very carefully made, and calls for more metal in the centre of the crank disc than is necessary in a one-piece shaft, but this is not a very serious disadvantage, and does not add so much to the weight as might be expected.

It is advisable to make the "large end" first, as this involves the most awkward machining, and it is easier to fit the journal to it than *vice versa*. Although the material specified for the component is high tensile steel, and this is certainly desirable if it can be obtained, difficulties in the latter respect have caused me to investigate the possibilities of mild-steel, and I am glad to be able to report that a shaft made in this material has been found quite satisfactory. If, however, constructors have access to better material, such as 3 per cent. nickel or medium nickel chrome, by all means use it.

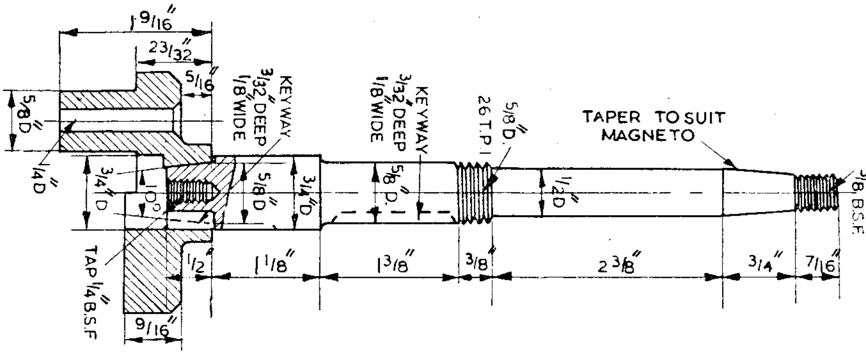
If the material used for the disc is reasonably clean and free from scale or pitting, it may only need a mere skim on the outside, but if not, larger material must be used, and rough-turned to just over finished size in the preliminary operation. The two ends are faced true and parallel, and one end is then marked out to show the position of the crankpin, at ¾ in. radius from the main centre, also the outline of the web and balance weight. As these marks should be bold and clear, it is advisable to use spirit marking dye, or in the absence of this preparation, any quick-drying paint, such as cellulose, or pattern-



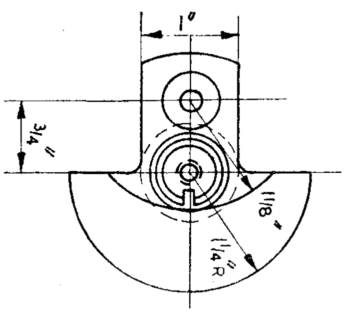
(13) GUDGEON-PIN & PADS
1 OFF MATERIAL M.S.C.H & BRASS

maker's colouring, may be used. The appearance of the marked face of the disc is shown in the photograph, and in view of the need to avoid removing these marks in immediately subsequent operations, the disc is chucked with this face inwards, so as to run truly on the diameter and end face. It may then be machined to form the centre boss, chamfered on the edge, and drilled and bored through the centre, a hole ½ in. dia.

being carried right through the disc, and the outer end bored to an included angle of 10 deg. Great care must be taken to produce a smooth and accurate finish of this surface, and the boring tool must be set with its cutting edge exactly at centre height. The exact dimensions or angle are not highly important—measurement of tapers would have served equally well if properly hardened and tempered. It was ground on the end face to produce a rake angle of about 10 deg., and clearance ground on both sides as for a parting tool, i.e., tapered towards the back, and for a sufficient length to clear for the full length of the slot ($\frac{1}{2}$ in.). If an adjustable tool rest is available



Details of crankshaft assembly



End view of crank disc

is extremely difficult, anyhow, unless special gauges are available—as the shaft can be fitted later, but the outer end of the hole should be approximately $\frac{5}{8}$ in. diameter.

It is now advisable, temporarily, to reverse the disc and counterbore the centre hole to $\frac{3}{4}$ in. dia., to within $\frac{1}{2}$ in. of the back face, though it is possible to carry out this operation at the original setting, if a suitable internal recessing tool is available. Most workers, however, object to "blind" boring in this way, and it certainly involves some risk of damage to the taper bore in view of the restricted clearance for the entry and withdrawal of the recessing tool.

The keyway for locating the disc on the shaft may be cut, by means of a suitable slotting tool, while held in the chuck. In the case illustrated, advantage was taken of the facilities offered by a special toolholder designed to fit the Myford height-adjusting packing block, but it should be noted that in this instance it is absolutely essential to keep the tool dead horizontal, and, therefore, its height had to be adjusted by parallel packing strips in the usual way. The cutter was made from a piece of $\frac{3}{16}$ in. square high-speed steel, as used for standard forms of holders, though silver-steel

on the grinder, it will be quite easy to grind the clearance angle accurately, and in such a way that the full width of the stock is maintained at the cutting edge, a slight "witness" being left here, to be finally finished with a honing slip.

It will be noted that the keyway does not follow the angle of the tapered bore, but is cut parallel to the axis. This is a comparatively unimportant point so far as the fitting of the key is concerned, but it makes a great deal of difference to the task of slotting the keyway in the lathe, in the manner illustrated. If the line of the keyway was parallel to the angle of taper, it would be necessary to take the cut by operating the top-slide, and unless special fittings were made, this would entail the use of the feed screw. But by cutting on the axial plane, however, the rack feed of the saddle can be used, which is much less laborious, in spite of the fact that a greater total depth of cut must be taken in this case.

For setting the tool to centre height, it is a very good idea to remove the work from the lathe and set up a piece of $\frac{3}{16}$ in. dia. round bar, preferably in a collet chuck, so that it runs quite truly. By bringing up the tool either to the end or rear side of the rod, any discrepancy in the height of the two will immediately be apparent, and may be checked still more accurately by laying a straightedge across the rod and the extreme tip of the tool. The cutting face of the latter should be inclined about 5 deg. to the lathe axis, to provide back clearance.

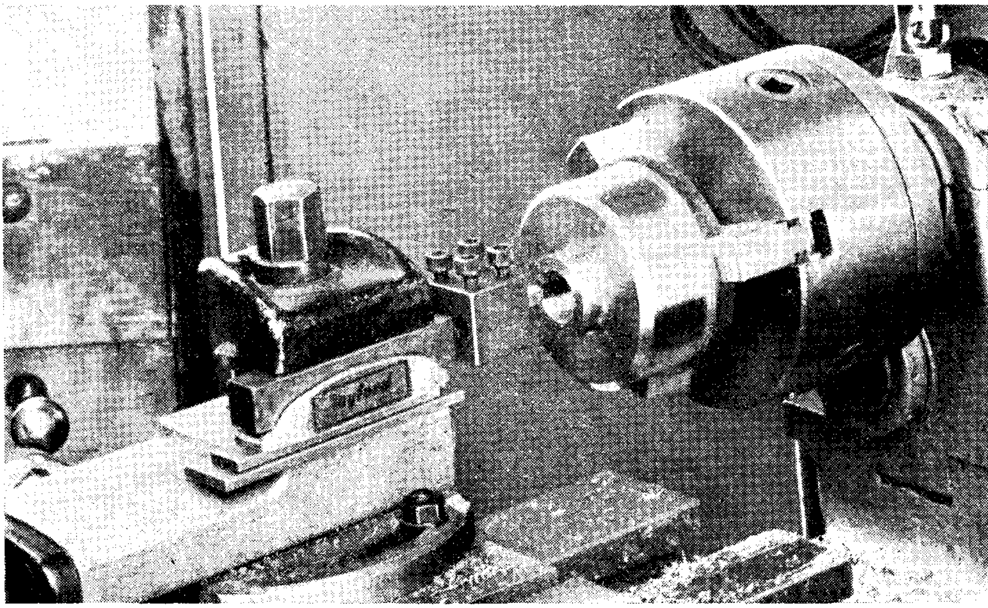
Success in cutting slots in the lathe by this method is largely a matter of patience. It is no use whatever to try to take heavy cuts in this way; however firmly the tool is fixed, it will either shift, spring, or dig in if overloaded; much better to "make haste slowly" and take delicate nibbles, which will result in clean, easy cutting, and leave a polished surface if the tool is sharp. About 0.005 in. is about the deepest cut it is desirable to take, and a number of "running out" cuts should finally be taken at the same setting, to eliminate spring. I have on several occasions had

to cut serrations or multiple splines in this way, and have even made an internal toothed gear by the same process.

Removing Surplus Metal

It will no doubt be appreciated that in the operations so far carried out, the circular form of the disc has been left intact to facilitate holding it in the chuck ; but now it will be advisable to get rid of some of the unwanted material, to reduce the amount of work in machining the crankpin. The outline of the crank web may, therefore, be shaped, working to the lines already marked out on the back face, and utilising any methods which may be available. Most workers will probably have to resort to the use of " Armstrong's patent," as my old foreman used to call it—in other words, purely manual methods, in which the good old-fashioned hacksaw and file play an important part. In this case, it is advisable to mark out and drill two $\frac{1}{4}$ in. holes to touch the lines bounding the angle of the web and balance weight on each side ; these will form a useful guide in cutting and filing operations, and also form fillets to avoid sharp internal corners at these points.

After the two segments have been removed, a cut may be taken at right-angles to the axis, to remove the surplus metal from the front of the balance weight, leaving it $\frac{9}{16}$ in. thick, plus machining allowance. An axial cut will, of course, have to be made just below the crankpin to join up with this and detach the slide of metal. Take care to avoid risk of cutting into the crankpin when making either cut ; hacksaws often run away at queer angles, and in the stress of physical exertion, one's finer perceptions are sometimes a little below par, so it is better to err on the side of allowing a little extra for machining than otherwise.



Cutting the internal keyway in the bore of crank disc

Machining the Crankpin

The disc must now be set up with the crankpin centre running truly. Methods which have been described for machining overhung cranks in the past are not applicable here, as there is no parallel shaft or stalk available which can be held in a vee angle-plate or eccentric fixture.

It is, therefore, necessary to clamp the disc to the faceplate, using the flat face of the rear boss as a bearing surface ; but here a difficulty arises, as the centre hole of the faceplate prevents it making a really good contact at the required radius, and clamping in such a way as to enable the front of the disc to be machined is also a problem. In these circumstances, a " false faceplate " or parallel packing plate, to which the disc may be clamped, and which in turn is mounted on the faceplate, offers the best solution. It is not absolutely essential to use a plate either so long or so broad as the one illustrated here, but it should be big enought to provide an adequate bearing surface, and should be checked for flatness and parallelism before use. A piece of bright mild-steel flat bar is suitable if it is free from bends, twists, burrs or bruises.

The disc is clamped to the plate by means of a central bolt having a head not more than $\frac{1}{8}$ in. thick, as anything thicker will get in the way when machining the front of the web. It should either be screwed into a tapped hole in the plate, or secured by a sunk nut at the back. To prevent the disc turning under the torque stress of the machining operations, stop blocks or dogs should be attached to the plate, to bear against the sides

of the web or balance weight, and these also should not project far enough to foul the cutting tool. The plate is drilled near the ends to take bolts for securing it to the faceplate, and the positions of these should be chosen so that they allow of centralising the crankpin.

In setting-up, the use of a " wobbler " or similar centre-finding device to work off the marked centre-pop will be found useful, but although accuracy in this respect is highly desirable, a few thousandths of an inch difference in the crankpin radius will not affect the working of the engine to any appreciable extent. The thing that really matters is that the crankpin should be truly parallel with the shaft axis, which is positively assured if this method is properly carried out.

All is plain sailing now for the machining of the crankpin, also the facing of the front of the web and balance weight, but here again, caution is called for, as the cut is mostly intermittent, at least in the early stages of the work, and attempts to force the pace may be disastrous. However, there is nothing in the job that the beginner cannot do by taking due care. A well-raked side tool with a small radius at the tip should be used. The crankpin should be turned to exactly $\frac{5}{8}$ in. dia., truly parallel, and with as high a finish as possible, to avoid the need for a great deal of abrasive polishing. Most of the facing can also be done with the same tool, with the exception of the inside radius where the balance weight is scooped out to clear the counterbore ; this will call for the use of a boring tool or a small left-hand side tool with plenty of clearance. The hole through the centre of the crankpin can also be centred and drilled at this setting, and although there is no real necessity to do so, a skim off the face of the pin is desirable on the grounds of appearance. *(To be continued)*

BROOK FILMS AND FILMSTRIPS

WE have recently received from Messrs. Brook Motors, of Empress Works, Huddersfield, a pamphlet describing an interesting range of films and filmstrips which might well prove of interest to model engineering clubs and societies. They are available to all on free loan, together with special filmstrip projectors if required, and a commentary for each frame.

Filmstrip No. 1.—" General Motor Applications "

No. of frames 35. Approximate time 20 min.

A selection of photographs, showing the application of Brook motors, various types, to a wide range of trades from textile manufacturing to quarrying.

Filmstrip No. 2.—" Motors for Farms and Dairying "

No. of frames 30. Approximate time 20 minutes.

A fairly comprehensive coverage of the most suitable types of motors for use in farm and dairy machinery. Barn machines such as group cutters, food mixers, grinding mills, etc., are included together with pumping drives for milking and up-to-date driving equipment.

Filmstrip No. 3.—" Motors for Engineering "

No. of frames 30. Approximate time 20 min.

A helpful strip showing motor applications in this great industry ; foundries, machine tools and cranes.

Filmstrip No. 4.—" Selecting the Right Motor "

No. of frames 40. Approximate time 30 min.

Covering a wide field, showing a selection of the most widely used motor types, with installation photographs as guides in each case. Of interest to all who install and maintain electrical motors in any trade.

These strips are most useful for making up an evening's programme in conjunction with the films. Technical and trade societies will find them interesting, particularly where they apply to members' own trade.

They also form a useful basis for teaching in courses involving electrical motor installation in the appropriate departments of technical colleges. It should, however, be clearly understood that neither films nor filmstrips are made as teaching mediums in themselves. Advertising has been kept to the minimum throughout, but they are intended to publicise the Brook products and services.

" Power Without Smoke "

A 16 mm. sound film, showing time approximately 20 min.

This film argues the case for the individual electric drive. It was shot on locations centred in the heart of Britain's textile areas, and endeavours to show how the application of the individual drive has been introduced into every process where mechanical movement takes place.

" Distinguished Company "

A 16 mm. sound film, showing time approximately 40 min.

In the production of this film it has been the intention of Brook Motors to present an over-all picture of their establishment which may help those people interested in up-to-date electrical motor construction to learn something of their methods and approach to modern production technique.

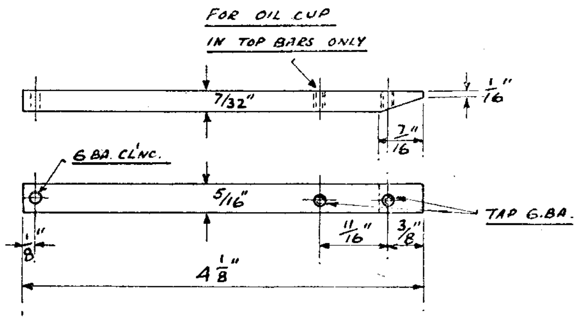
Copies of the leaflet in question may be obtained from the Brook Motors Ltd. Film Library, at the aforementioned address.

*TWIN SISTERS

by J. I. Austen-Walton

Two 5-in. gauge locomotives, exactly alike externally, but very different internally

AT this stage we come to what I always feel is one of the most interesting parts of the job; the moment you hang the cylinders on the frames, even in their incomplete state, the assembly begins to look like a locomotive, and for the man who is building his first locomotive, it is a thrilling event. I think we have all been guilty, at some time or other, of standing a bit of boiler barrel, a chimney and dome, plus a few other bits of appropriately shaped metal, on top of whatever exists in the way of a chassis, just in order to get some idea of what the finished job will be like; we seldom get a very exact representation of the final unit, but it is funny how irresistable the temptation becomes. So now we sigh, take off all the bits, and get down to scratching out something on the bench or lathe.



GUIDE BARS. 4 OFF. IN STAINLESS STEEL.

Guide Bars

You could not have a simpler job than this to break up the reverie. The bars are of uniform rectangular section, with sloped-off portions on the inside of each back end. The amount of slope-off may vary slightly from the drawing, according to how your engine has worked out; and do not be dismayed if the fixing stud breaks out somewhere before the slope ends. So long as the stud itself does not project above the surface of the bar, all will be well. In any case, before final fixing, remove the stud and reduce its length by about a 1/32 in., doming the end of the thread portion slightly at the same time. With the wheels dropped to the bottom of the horns, the connecting-rod should not touch the bottom guide bar when they are rotated, and with the wheels fully pressed up, the same conditions apply to the top bars. Both bars are exactly alike, with the exception of the tapped hole for the oil cup, but do not forget to mark all bars on the inside edges, so that they can be fitted and refitted without upsetting the final adjustments made.

Expansion Links

I cannot dispose of these items quite so easily, and as so very much depends on these parts for their accuracy and, therefore, correct valve-setting and steam distribution, I propose to give the section every consideration.

First of all, take a good look at the drawing. You will see that it is a composite member comprising the link itself and two trunnion brackets with their pins screwed and silver-soldered in place. The trunnion brackets, with the actual link between them are held together with three steel rivets. The link is made from a piece of stainless steel, ¼ in. thick, and finished smooth (but *not* polished) each side. I mention the question of polish because I have noticed amongst the enthusiasts a distinct tendency for the polish to go up with the enthusiasm; this is wrong (but forgiveable). I shall mention, once more, that whereas the finish produced by rubbing the part on emery-cloth placed on a good flat surface, does do the trick, I contend that there still remains distinct evidence of some rounding or "blearing off" near the edges. Draw filing—where the operator really *does* know how to carry out the operation, and uses a file that is not loaded with lodged particles of metal, gives a very good and *correct* finish; but for the man who still has trouble with finish, the coarse oilstone used with paraffin or very thin oil, will give the best results of the lot.

Going back to the drawing, notice how the link is marked out, and try to arrange your scribing out on the same lines. The significance of this is very much tied up with the general geometry of the valve motion, and with the tail link in particular. The tail link *has* to be set back as shown, for this very reason, and the easiest way of marking its critical location is best obtained through the intersection of a couple of arcs—just as the drawing gives it. Many builders fight shy of the radial slot in the expansion link, and choose a direct machining method as a guarantee of accuracy.

There is still a small wasp in the jampot regarding finish—the sort of average finish left by the average end-mill. If these slight ripples are to be removed, and they *must* be removed, of course, then it resolves itself into a hand operation once more, and much of the value of

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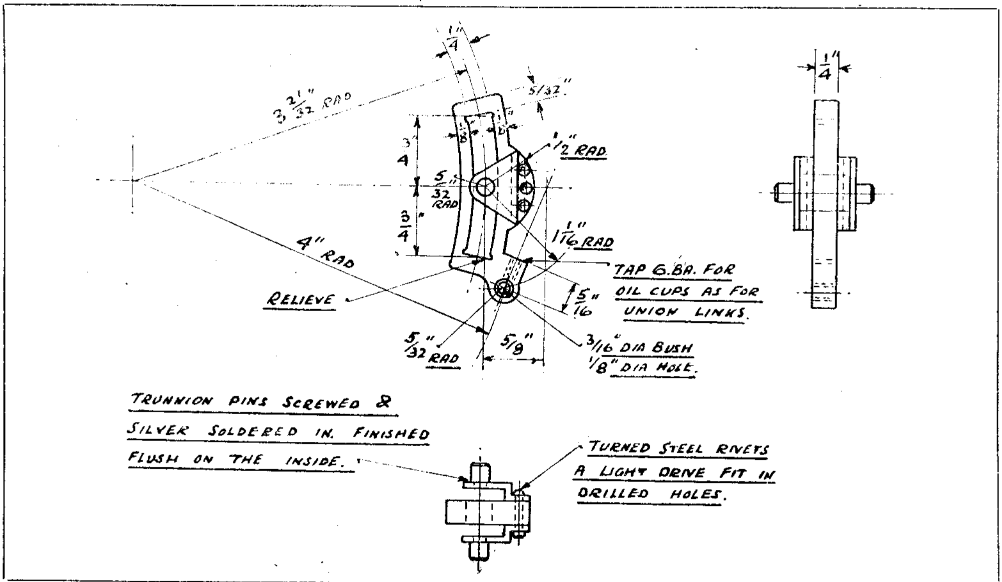
*Continued from page 571, "*M.E.*," *May* 3, 1951.

the original machining operation is lost. I contend that, if the slot is well and accurately marked out, a number of holes are drilled to remove the bulk of the metal in the slot, and that, given time and care, you can really file to a line, then you will achieve a link that will equal any link machined. The die-blocks will have to be made, and these will have to slide up and down in the slot, without too much (preferably without

The outside edges of the link are merely a matter of filing and finishing to shape, but, before we forget it—do not fail to put in the little clearance slots at each end of the main link slot; there is no call for these to be very deep, and so long as they are just visible, all will be well.

Trunnion Brackets

These, you will see, I have suggested making



any) shake; this may well entail filing a little out of the link in parts, as well as filing something off the block. In any case, the inside surface of the link slot will call for a very good and even finish ultimately, and once more, the oilstone slip, dipped in oil or paraffin, will provide the necessary. I shall remind newcomers that on most engines, and especially on this engine fitted with swinging lifting links, that when the locomotive is working, the die-blocks will be on the slide—up and down slightly—all the time the wheels are turning, and decreasing only as mid-gear is approached from either direction. But for those folk who will want to machine the slot, even if it is with the sole purpose of making a true start, I will still give the two best methods known to date. The first (and most luxurious) is to set the link on a rotary turntable, and cut the link with the aid of an end-mill running in the vertical head of a milling machine; even then, if he is wise, the builder will use an end-mill smaller in diameter than the finished slot, so that he will escape "climb" when getting near the finished size. A more popular method amongst the "lathe only" brigade, is to fix the link on a temporary swinging arm, and traverse it past an end-mill running in the chuck; it would still be well to take note of the end-mill size, and to follow out the procedure just mentioned—it is no more difficult on a lathe than on a milling machine.

out of a milled strip, and a little diagram is included in the drawing. I like this method because it does two things; it saves time and it makes for uniformity. When making up these parts, file out the profile, but leave the round backs of the brackets a bit full—the reason for this will become apparent later. Make up the trunnion pins, but *do not tap the holes in the brackets at this stage.*

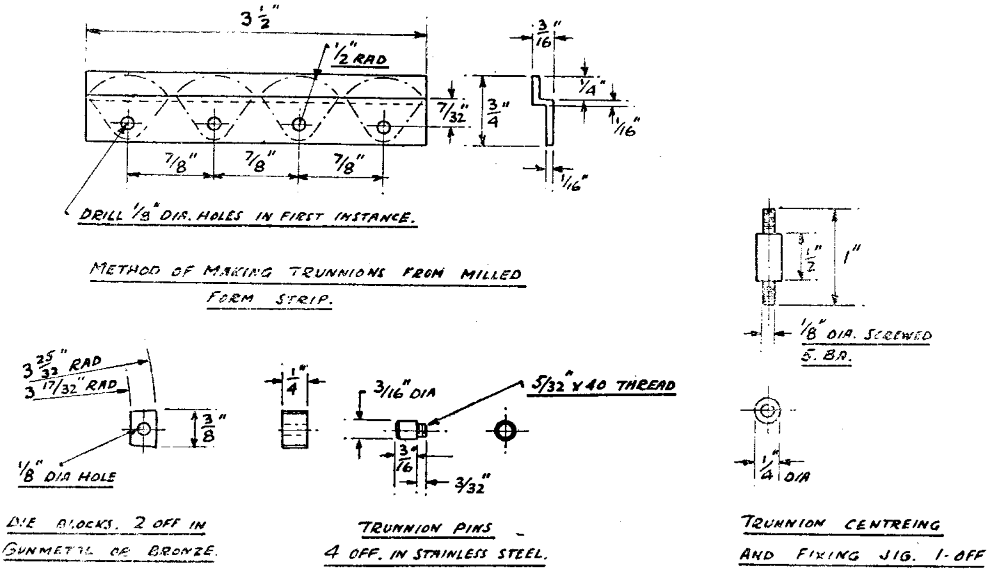
Now set about making up the little setting piece, or trunnion centring jig which is a very simple piece of work; even this calls for just enough care to ensure that the body of the pin is quite true to the turned down and screwed ends, otherwise the value of the part as a jig, is lost. The jig pin, when finished, should be a snug fit in the slot of the link and should be used in the following way:

Put the jig pin in the centre of the slot, and thread the two trunnion brackets over the threaded ends, fixing up with temporary washers and nuts. The pin should also be in the centre of the slot in the other plane as well—that is to say, in the true mid-gear position; extra-cautious folk may want to hold it in this position with the aid of two extra blocks or strips of metal, wedged in to the link slot on either side—quite a good plan.

The trunnion brackets will now be held quite firmly in their true axial position, when the body of the bracket can be swung round to coincide with the "hump back" of the link itself, when it

can be still further clamped with the aid of a small toolmakers' cramp. If the cramp is positioned a little to one side, it will allow you to mark and drill the first hole for one of the three special steel rivets, mentioned earlier on; this hole should be drilled undersize and reamed to its final size after. You can now turn up the first of the steel rivets from stainless or high tensile steel, making sure that it really does fit the hole correctly—a light tap-in fit should fill the bill admirably. But do not rivet over at critical, but it will have some bearing on the accuracy of the valve-setting at large.

Any final thoughts on the matter? Only in the way of alternative materials. Expansion links made from gauge plate (a super-quality cast or silver-steel) hardened and tempered, with die-blocks also hardened, make a combination that will resist wear for almost all time, in fact, I know of no better or easier working specification than this; if the rust bogy doesn't bother you—go ahead.



this stage; put a good fitting bolt and nut in for the time being, turning one down specially for the job if necessary. Drill and ream the other two holes and make the remaining rivets. When both expansion links have been so treated and the brackets marked to avoid confusion, the bracket trunnion holes can be tapped and the pins screwed and silver-soldered in, and the parts cleaned up. Now you can rivet up the job for keeps, forming a neat snap-head on the back faces of the brackets. The heads, or outside showing portions of the rivets may be either snap or cheese headed (without screwdriver slot, of course) according to taste.

As a final word of advice on the subject, you may prefer to make and fit the die-blocks while the link is in a free state, or before the trunnion brackets are riveted on; it does make the job much easier to do. The die-blocks should be made in the very best bronze or gunmetal obtainable. The question of cost here can hardly apply; there is so very little actual metal used for these, that the necessary supply might well be found in the scrap box.

As to the machining of the die-blocks, I really do not think it worth while setting up to do. As I said before, you will doubtless have to apply the file judiciously here and there, and the actual machining will be a lost quality. Do try to get the hole in the block truly central; it may not be

Radius-rods

When first I set out the various parts of the motion work, it was fairly obvious that the radius-rod was going to rank as one of the most troublesome to make. A more annoying and wasteful shape could not be imagined, but when completed, it looks a treat.

There is very little I can do to ease the burden for you except for the "Minor" builders, who will be forgiven the flute on the outside, and even that is parallel and quite a simple job compared with the tapered flutes elsewhere.

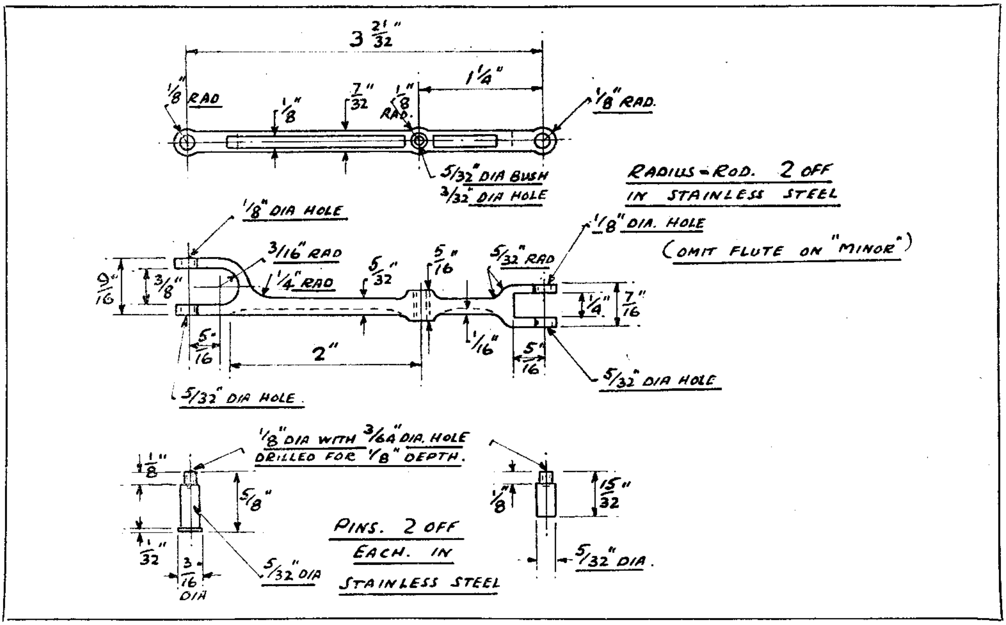
Since it is a "handed" job in its true sense, I set out the rods on a piece of plate in that way, so that I could slash out the outline of both rods at the same time. Very often, the problem of making intricately shaped rods resolved itself—in the end—to that of holding the blessed things without damaging them, and I evolved a method that I think is unusual, but most effective.

Suppose you start with a piece of plate of the required finished thickness, having marked out the outline of each rod, side by side, and leaving enough room between them to allow the size of end mill being used, to pass. Whether the plate is set up on a milling machine or a lathe, does not matter in this method, but laid out flat on a milling machine table does help a lot, visually.

Knowing the exact thickness of the plate, you touch down with the end of the end-mill, noting

at the same time the number on the thimble of the rise and fall table handle ; thus, if the feed screw of the machine were to have ten threads per inch (the usual) and the plate thickness were ¼ in., then two and half turns of the handle would give you the full depth of the plate—that's the principle. In my method, I calculate the number of turns so that about ten thousandths are left in the bottom of the cut, which enables but if you are a " Major " builder, the difference in appearance makes it worth while going to the trouble of forming the swelled ends. If, while the plate blank is still in the unbroken slab form, you mark out and end-mill off both sides the surplus 1/64 in., the remaining work of forming the radii should not bother you.

The central boss (figuratively speaking) when all other machining operations have been carried



me to keep the two rods—almost completely profiled out, and still firmly held in the plate blank. With the chewing out operation done, I can remove the rods in " embryo," and break them apart, just as you can with a slab of toffee, which is deeply scored or moulded for this very purpose. You are then left with the two separate parts on which remains a sort of " flash " which, being so thin, can easily be cleaned off with a file. I used this method for both radius-rods and combination levers, with great success. If you decide to have a shot at this, spend a few moments thinking out the best relative positions of the rods to be, when doubtless you will see how one travel of the end-mill will complete a side on two rods ; for example, note the external radii called for, which will give you the diameter of the end-mill to be used ; a change in size of end-mill during the machining operation, will not disturb the set-up in any case, and no time will be lost.

Two other points come clearly to mind regarding the rods themselves ; one is the centre boss, which is for the lifting link, and the other is the swelled-out radius round the ends of both forks, and which denotes the original thickness of the plate blank before machining—that is, ¼ in. and not 7/32 in. as given for the main arm thickness. I think we might allow " Minor " builders to use the normal ¼ in. thickness throughout ; out to date, will present a square appearance ; but by setting up a small bolt or piece of rod in the lathe chuck, and screwing the end, you will be able to mount the rod on this, first one way and then the other, and to turn down the round portion projecting beyond the body of the rod. Remember that the rod holding the job will be of very small diameter, and keep your cuts in proportion.

After all these operations, the job of fluting the rods will be just too simple. As a point of interest only, the prototype has a " stopped " flute where it meets on either side of the central boss ; this could be copied by doing the ordinary flutes as shown on the drawing, and following on with an end-mill to the sides of the boss. I venture to suggest that you might have trouble in getting the subsequent end-mill cut to mate up with the original flute. In any case, I am against this point being adopted as we have not got too much strength to spare, and a flute that dies out gradually is much stronger than one that ends rather abruptly and at full depth.

The Lucky South

One of the things I used to dream about, but which never seemed to come into the realm of possible reality, has happened—or rather, is on the point of happening. This dream, as you might well imagine, was of a track of con-

siderable length and beauty, with scenery, curves, reverse curves, gradients, cuttings and the rest, and not the usual rather monotonous oval, set in the middle of some shelterless field. But remember, this was a dream, and in no way decries the advantages of the usual form of track, which is still possessed by the more fortunate of us and our societies.

This last week (at the time of writing) saw the formation of a new society—The Sussex Miniature Locomotive Society, to give it its full title. Praise for the initiative behind all this must go jointly to the Brighton & Hove Society and the Mid-Sussex Model Engineering Society, in whose area the proposed site happens to be. In the early stages, I was invited to go along to meet certain gentlemen of the Cuckfield Urban District Council, with Brighton and Mid-Sussex Society officials, to walk the proposed site, and to study a provisional plan. From the moment I saw the place, I recognised qualities that had hitherto been shadowy, filmy dream material; there was scenery and shrubbery, gradient and vista. I think we all enthused on the way back, and the problems of finance and availability of material were thrashed out during that memorable journey. When I say "thrashed out," I do not mean settled by any means; a track with a circuit of a quarter-of-a-mile, is going to cost money, and we were all aware of this.

I was later called to the inaugural meeting of the new society, and was much honoured by being made chief mechanical engineer, whose job it is to settle track problems, gradients, transitional curves, super-elevation and last, but not least—materials to be employed.

But events have moved fast, and we have got down to brass tacks in an extraordinary way, even to getting quotations for track and foundation material, all of which adds up to a *minimum* of £500 to get the thing in actual operation.

Our secretary and treasurer, Ron Bostel, of 8, Cranbourne Street, Brighton 1, that well-known enthusiast and locomotive fan and builder, tells me that a sum of about £250 has been whipped up already, and he would be glad to hear of anyone who would like to share in the amenities of the new track, or help the society in the most appropriate way—need I say more? After all, this is a project where the scope is far too big for us to be selfish about it, and we want others to come in for both the piper *and* the tune.

(To be continued)

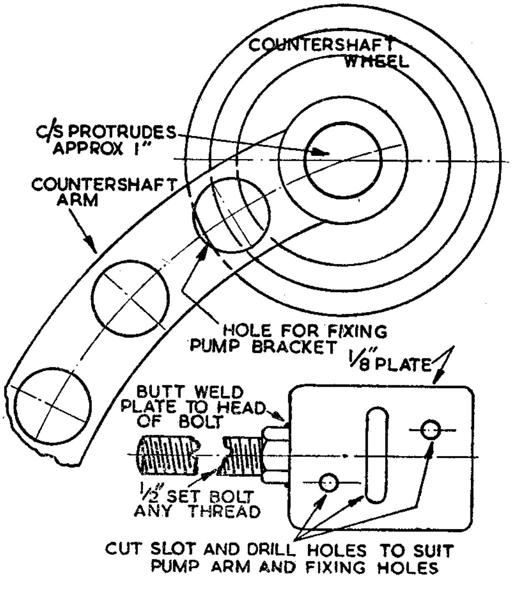
A Suds Pump for Your Lathe

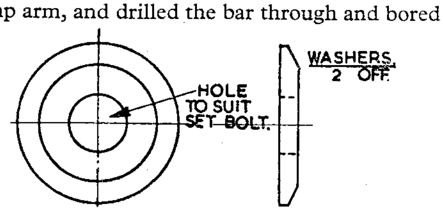
by W. R. Silvester

HAVING purchased a Granville lathe, I wished to instal a pump on it, out of the way of the working parts, to pump up the suds into a top tank, to be used over again. The countershaft arm was the locality decided upon, so I set off to the car breakers and purchased an A.C. fuel pump. This particular one came from an Austin "7" engine, but any type will suffice. Next, a delve into the junk box for a piece of $\frac{1}{8}$-in. plate, $2\frac{1}{2}$ in. × 3 in. or thereabouts and a $\frac{1}{2}$-in. set-bolt which came from an Anderson shelter. I butt-welded the plate to the head of the bolt, marked out and cut the slot, drilled holes to take the pump, and bolted it to the plate.

Next, I made up two chamfered washers to go on the set-bolt, one either side of the countershaft arm, and then clamped the bolt and plate on nice and tight, allowing it to swivel back and forth for adjustment on the pump arm.

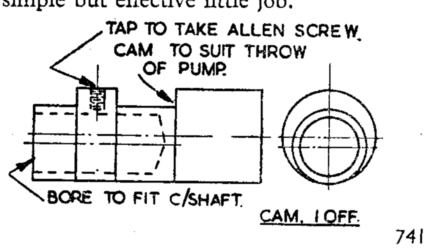
With a piece of 1-in. bar in the four-jaw chuck, I set it for a cam of a suitable throw to take the pump arm, and drilled the bar through and bored





for a nice fit on the stub-end of the countershaft. I then drilled and tapped for an Allen screw, for fixing the cam to the shaft.

Finally, a length of piping about 3 in. long was fitted in the feed and delivery orifices, and on them enough rubber tubing to reach the receiving and delivery receptacles. Thus was completed a very simple but effective little job.



Novices' Corner

Simple Methods of Case-hardening

CASE-HARDENING is the process by which a hard skin or case is formed on a component made of a steel having a low carbon content; that is to say, the surface of ordinary mild-steel can be converted to tool-steel and then hardened.

The purpose of this hard case is usually to resist wear. It might, however, be supposed that, in order to provide good wearing properties, it would only be necessary to make the components from a high-carbon steel, such as tool-steel, which could be hardened and tempered, as is usual with lathe tools, chisels and the like. Unfortunately, this is not a possible solution because hardened steel is rather brittle. Therefore, parts to be case-hardened are best made of a kind of steel that retains its strength after the surface layer, alone, has been hardened.

For commercial work, steel makers provide special steels for case-hardening that vary from low-carbon mild-steels to nickel-chrome high tensile steels having an ultimate tensile strength as high as 90 tons per sq. in.

The amateur worker is usually only concerned with the case-hardening of mild-steel componets, for the methods needed to heat-treat the other forms of steel are generally beyond the resources of the small workshop. Although ordinary mild-steel can be satisfactorily case-hardened, a special case-hardening steel, such as Messrs. Flathers UBAS, will, as a rule, give rather better results.

The principle of case-hardening is to cause the outer surface layers of a mild-steel part to absorb additional carbon and so be converted to tool-steel which may be hardened to resist wear. The core remains as mild-steel and thus gives strength to the part.

The addition of carbon is brought about by keeping the work at a red-heat when in contact with a case-hardening compound. In commercial practice the depth of case does not,

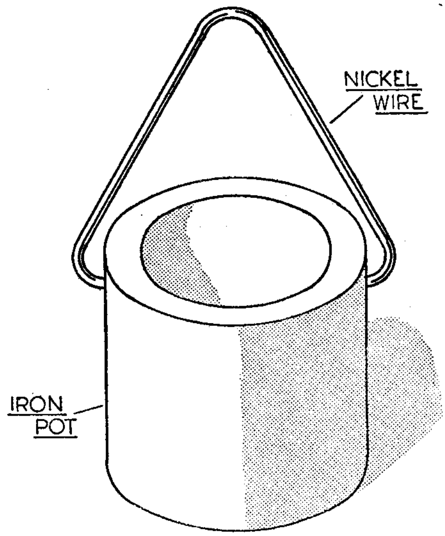


Fig. 1. A container for case-hardening

normally, exceed 1/32 in. Any increase on this figure entails uneconomical working, though some case-hardening compounds, which have certain chemicals added to them, are somewhat quicker in action than others and so produce a deep case more rapidly.

There are three methods of case-hardening, and of these the first two are commonly used in the small workshop. These are the open hearth method, the molten bath method, and the closed box method.

The Open Hearth Method

This method consists, simply, of applying heat to the work by means of a brazing torch or a blowlamp, then either sprinkling the component with case-hardening compound or dipping the part in the material. The work is then re-heated to a dull red-heat and maintained at this temperature until the molten compound flows over the part.

The heat is kept on for a minute or so, and the work is then again immersed in the hardening compound, and re-heated as before. To obtain a sufficient depth of case, it is usually necessary to apply heat for ten minutes or so before plunging the work into clean cold water, and during this time several applications of hardening compound may be needed.

From the foregoing remarks it will be apparent that this method is haphazard, and that there is not full control of the depth of case-hardening produced. Whilst the process will serve well enough for work of little importance, it suffers from the great disadvantage that burning of the work is all too easy. This burning is caused, by atmospheric oxygen reaching

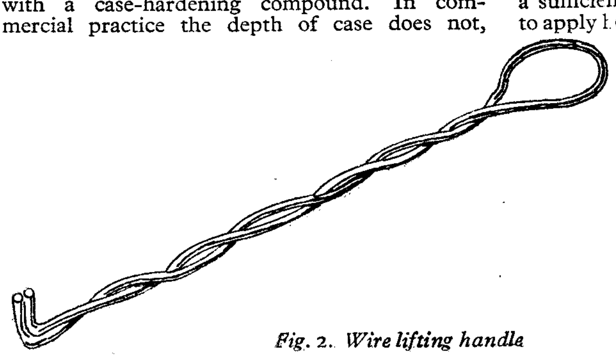


Fig. 2. Wire lifting handle

the surface of the work when red-hot, and is recognisable by the hard scale which forms. This destroys the surface and mars the appearance of the component.

If the hardening compound is kept in a molten state over the work and is not allowed to burn off, excess oxygen will be excluded from the surface and the part, after being dipped in cold water, will present a bright appearance.

It is advisable to use one particular brand of hardening compound and to adhere to this, for by so doing, satisfactory results can be obtained with certainty.

Personal experience, extending over a number of years, has shown that "Antol," a compound marketed by Messrs. Pidgen Brothers of Helmet Row, London, E.C.1., is easy to use and gives good results. The makers themselves recom-

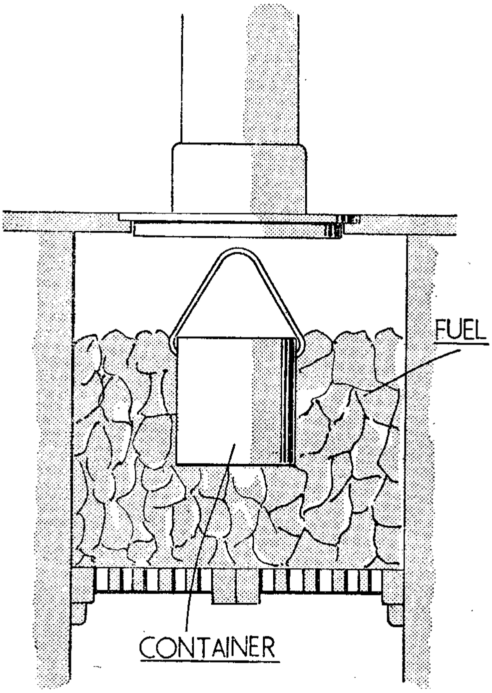


Fig. 3. Packing the container in the fire

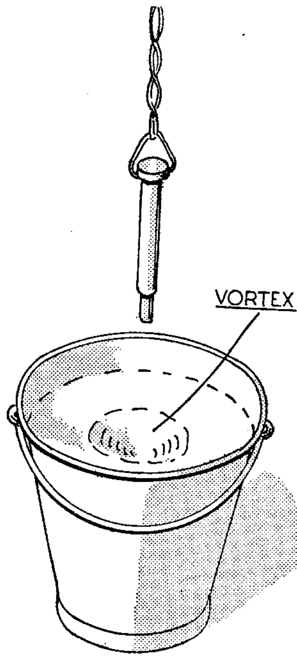


Fig. 4. Quenching the work

mend the molten bath process, as this ensures that any parts so treated receive a uniform case, and are left bright after hardening.

The Molten Bath Method

The troubles inherent in the open hearth method can, fortunately, be largely overcome by using a bath of molten case-hardening compound in which the work is submerged and retained at red-heat. As a result, the part when quenched in cold water, will have a silver grey appearance, and may be polished to a mirror finish with fine abrasives such as lapping compounds.

The molten bath method has the additional advantage that it enables test-pieces, composed of short lengths of the same steel as the part to be hardened, to be put in with the work. From time to time, one of these pieces is withdrawn, quenched and then broken in the vice. The depth to which the case-hardening has penetrated can then be seen clearly, for the case will appear as an area composed of fine grey crystals, whilst the core will be seen to consist of a mass of much coarser crystaline structure. The test-pieces must, of course, be of such a size that they are easily broken when hit with a hammer. They are, therefore, conveniently made from round rod some $\frac{3}{16}$ in. in diameter.

The bath consists of a cast-iron or mild-steel container for the "Antol" and is heated to a dull red to melt the compound. The inner container of a cast-iron glue-pot makes a very satisfactory bath, for these pots are thick enough to withstand the erosive action of the compound for a long time. Moreover, glue-pots usually have a substantial wire handle which is essential for lowering the container and removing it from the furnace.

A better and more durable bath can be made from a petrol engine piston casting ; this should have the gudgeon-pin bosses machined away so as to form the thick-walled pot illustrated in Fig. 1. Two holes are drilled in the walls of the container, and into these there is fitted a loop of heavy-gauge nickel wire ; electrical resistance wire will serve well, as it is heat-resistant and is but little affected by the "Antol."

A lifting device will be needed for raising and lowering the bath into the stove ; this may

conveniently be made by twisting a length of stout galvanised iron wire into the shape illustrated in Fig. 2. As will be seen, this tool is provided with a loop handle and is hooked at the lower end so as to catch the wire loop attached to the iron pot, or to remove, individual components from the bath.

When putting small components into the pot, it is advisable to wire them together so that they can be easily withdrawn ; for this purpose larger work should also be furnished with a wire loop. Although iron wire will serve, it is better to use a nickel wire, as this material is but little affected by the hardening compound.

The makers of " Antol " recommend that the parts to be hardened should be heated to a dull red-heat before being immersed in the molten compound. The liquid must completely cover the work, in order, as far as possible, to exclude oxygen. Although the time needed for treatment will vary with the type of steel used and the depth of case required, immersion for ten minutes is usually sufficient to produce a light case, that is to say one having a thickness of some 0.005 in.

Adoption of the maker's recommendation to pre-heat the parts before immersion is hardly necessary when case-hardening small components, and usually it will suffice to bury the work in the cold case-hardening compound and to heat both the container and its contents simultaneously. Small screws may be dipped directly into the molten " Antol " ; but care must be taken to see that the parts are dry and free from oil or grease, otherwise there may be dangerous sputtering of the liquid compound.

Heating the Case-hardening Bath

Undoubtedly the best method of heating the bath is to place it in a furnace, for in this way the container is evenly heated. No elaborate equipment is needed, and the domestic independent boiler is excellent for the purpose. As the draught on the fire can be controlled, the contents of the bath are readily maintained at a constant temperature for long periods. When the bath is heated to a cherry-red, corresponding to a temperature of 900 deg. C., the " Antol " compound will be seen to boil. The container should be kept at this heat, for at this temperature the case-hardening process is most rapid. When placing the bath in the furnace, fuel should be built up till it is level with the top of the container, as illustrated in Fig. 3. In this way, heating will be both rapid and evenly distributed. If the bath is merely stood on the top of the fuel, heating will be slow and uneven ; moreover, there is always the danger that the container will capsize and spill its contents into the fire.

The use of test-pieces for determining the depth of case has been described, but, as experience is gained, it will be found that the time required for immersion can quite well be estimated.

Quenching the Parts

After the heating process, the parts are quickly quenched by immersion in clean cold water. When the parts are dipped, there is usually a report like the crack of a whip ; this is accompanied by the scattering of small particles of the hardening material as it becomes detached from the parts at the moment of immersion. As this material is highly corrosive, the quenching should be carried out well away from any machine tools or bright metal surfaces likely to be affected.

As plunging red-hot components into cold water is apt to distort them, a liberal allowance of material is left on commercial parts so that they can later be finished to size by a grinding process. In addition, it is sometimes found necessary to straighten the parts before grinding is undertaken.

This correction by finish grinding cannot usually be carried out in the small workshop ; but if care is taken, small parts can generally be hardened with but little distortion.

Long slender parts are the most apt to distort when being quenched, and they should, therefore, be dipped vertically into the water, as illustrated in Fig. 4. When a slender part is dipped hori-

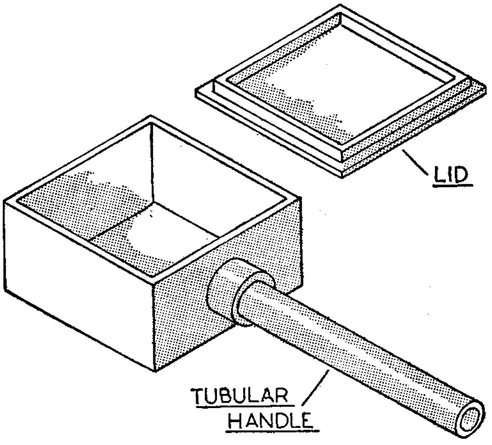


Fig. 5. A case-hardening box

zontally, the lower surface meeting the water will contract locally and will thus cause the work to bow. Before a part is dipped vertically, the water should be stirred with a circular motion so as to cause a vortex, and it is into this small whirlpool that the work should be plunged.

The Closed Box Method of Case-hardening

In the third, or closed-box, method of case-hardening, a steel or cast-iron container fitted with a lid is used. Excellent boxes for the purpose are those used for domestic electric light wiring. These boxes are made of cast-iron and may easily be fitted with a tubular handle, as illustrated in Fig. 5.

Various hardening compounds are employed, but bone dust, which is perhaps the oldest, gives a beautiful mottled finish and leaves the surface of the work quite clean and uncorroded. " Antol " is certainly quicker acting, and when used in this way, should be mixed with charcoal in accordance with the makers' instructions.

After the parts have been carefully packed in the container and surrounded with a thick layer

of the compound, the lid of the box is sealed with clay to prevent the entry of air.

As in the molten bath method, test rods can be used, but, here, they pass through holes in the box lid and again are sealed with clay.

The container, when heated either in a furnace or in an ordinary domestic grate, is kept at a dull-red heat for a period determined, at first by using test rods, and, later by experience. Next, the box is taken from the fire and the contents are emptied into a bucket of cold water, for a large volume of water is required for cooling the parts and the heated compound rapidly, to make sure that the hardening is well done.

PRACTICAL LETTERS

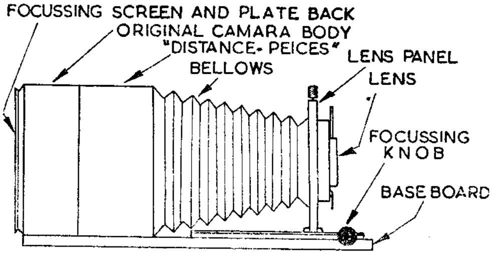
Camera Construction

DEAR SIR,—Your correspondents who ask for details of a simple camera for photographing models are misleading themselves over the difficulties. Construction of such a camera is a very simple matter, and need cost no more than a pound or two.

The essentials are :—

(1) A focussing screen ;
(2) A large negative ;
(3) Crisp definition ;
(4) Great depth of focus ;
(5) Rigidity.

Great depth of focus requires a small iris aperture, and a very simple lens can give first-class results under such conditions. Exposure will necessarily be long, and a simple shutter will suffice.



Any old-fashioned plate camera, either ¼ plate or 9 × 12 cm., with an anastigmatic doublet lens and simple " Vario " shutter will do. These cameras have a focussing rack and pinion, and a rising front, and can be made very flexible. They can be bought very cheaply, and I will be pleased to recommend a camera dealer to any reader interested.

The folding front of the camera should be unhinged, and the bellows stripped from the back of the camera. The two should then be mounted on a baseboard, and suitable " distance pieces " glued to the original camera body and the bellows re-attached. The whole must be light tight. Length of the " distance-pieces " can be found very quickly by focussing roughly on the usual distance the camera is to be from the model. The construction can be as flexible as the builder wishes. Coarse focussing could be effected by moving the whole lens and rack and pinion assembly, and fine focussing by the rack and pinion itself. The lens panel and the back of the camera must at all times remain in parallel planes.

Keep the whole assembly rigidly mounted to prevent camera shake. Use the smallest aperture possible. A quick trial will soon determine average exposure under standard lighting conditions. Use slow " Pan " plates and you should have no difficulty in producing negatives of absolutely first-class quality.

Should readers question why not buy a camera with double extension and be done with it—may I remind them that such cameras are very much more expensive, and the keynote of this subject has been low cost and simplicity.

Yours faithfully,
Glasgow. A. K. TULLOCH.

Model Steam Turbines

DEAR SIR,—It was with great interest I followed the articles on this subject by Mr. D. H. Chaddock; in the March 29th issue he said he has got up to 120,000 r.p.m.—good for him!

The purpose of my writing is to help him, and others, too, maybe, from my observations.

Back in 1942 I, in conjunction with a friend now deceased, started to build a little turbine with a 3 in. o.d. rotor. We only tried it on air (in bursts) as our compressor was too small to hold pressure. We got 30,000 r.p.m. once, but take little notice of this as a test, as it was only momentary.

Now to the subject of my letter. This rotor was shrouded by a ring of 3 in. copper tube, $\frac{1}{16}$ in. wall, shrunk on to the blading. During one of our speed bursts I was holding the turbine in my hands when suddenly there was a squeal and the turbine nearly twisted out of my hands, then purred on again at greatly reduced speed. On opening it up I found the shrouding had left the rotor and expanding by centrifugal force had stalled itself inside the casing which meant the circumference of the shroud had stretched about ⅜ in. I then shrunk on a steel shroud which held.

Now, I figure the lost revs. come from the loss of reaction, because, without shrouding, the air was expanding radially and less was giving up its kinetic energy by reaction.

Now, Mr. Chaddock's turbine was not shrouded and I feel he has more yet to be gained if only he will fit shrouding to his rotor. He stands to get either more torque or revs. from the same steam consumption.

Three cheers to Mr. Norman Ough's twin-screw, twin-reversing destroyer. Let's have some data and performance on this (I hope).

Yours faithfully,
Victoria, B.C. CLIFF BLACKSTAFFE.

Model Cars and Model Engineering

DEAR SIR,—It would appear from your correspondence columns that the model racing car " barometer " is still indicating " unsettled." It is also quite evident, as indeed it has been for a long time, that in the glaringly obvious motto of " Live and Let Live," we have the whole crux of the matter.

Surely no one will disagree with this very excellent principle, and it should be substantiated as clearly as possible exactly " Who is *not* letting who live ? " The answer might even be a little surprising to some !

Despite all the beautiful ideals expressed in the past regarding the fact that the model engineers will win through—often by those who are not trying to do so themselves—it is a definite fact that nearly all the odds are against the " home constructor," mainly owing to the intensive research put into, and the extremely high quality of the commercially-made engines produced by our American friends who have specialised in this branch for many years. The time factor also, is of great importance in competition work, and a serious " blow up " can mean many months of work for the home constructor, compared with the mere purchasing of the necessary replacements by the " commercial " competitor.

Down Different Streets !

Having *proved* last year that it is quite possible for an individual to establish national records and win national contests with a car purchased in its entirety, and requiring no more " gumption " than that necessary to install the batteries and fill the fuel tank, and also having devoted a good many *years* to the construction and development of an engine and car of my own, I feel I am in a position to state that the two approaches to obtain the final results are not even remotely connected !

Whilst there is undoubtedly much satisfaction indeed to be derived from seeing the results of one's own labours performing well, it is also ridiculous to pretend that there is no enjoyment to be had from running a car which has merely been purchased, as many can testify. In fact, I really believe that there is much pleasure derived from the triumph of *obtaining* a better engine than the next chap in the first place ! Certainly it is a fact that in every country, it is the person who has the best " contacts " in America who is almost always the " Champ " !

It is generally accepted, therefore, that the average individual can definitely *buy* a better engine than he is capable of making himself, and though quite a lot of folk have " had a go " at the latter approach, their numbers are dwindling, mainly owing, I believe, to the fact that in a great many instances they have to compete in the same race with the " purchased American engine " competitor, and this, coupled with the fact that they are consistently being beaten by those who have often not contributed more than a mere fraction of the time and work they have devoted to their own car is hardly encouraging, to say the least. Is *this* " Live and Let Live " ?

In an effort to bring about a state of affairs which *did* come more nearly to this ideal, I have for many years advocated that at all normal inter-club open meetings, the 10 c.c.—and now, apparently, the 5 c.c. class also—should be divided into two categories which can probably best be defined as " British " and " non-British."

No banning of *any* car (provided it complies with competition rules, of course) and both sides are happy competing against others *in their own sphere*. What could be fairer ?

During the last season, many clubs *did* try out this idea with good results, and I heard of no complaints from either camp apart from a few vague mumblings from the non-British car fraternity about having to provide additional prizes. This I discount entirely, for with a little rearranging of values, the extra prizes *can* be found.

Model car racing has developed into a " sport " these days, and one certainly does not need to be a model engineer to indulge in it ; in fact, the majority are *not*, and neither, I believe, are they in the least worried as to whether they have a right to this title or not.

It is, however, a great pity to see the craftsman and " home constructor " practically " frozen out," apart from a few stalwarts, and I suggest that those who, in their innermost selves, know they are responsible should have another look at that admirable motto !

Yours faithfully,
Stoke-on-Trent. F. G. BUCK.

Use of Bostik Cement

DEAR SIR,—I note that Mr. E. J. Baughen, of the Malden and District Society of Model Engineers, in his article published in the issue of THE MODEL ENGINEER dated March 29th, 1951, complains of the lack of adhesive power of Bostik cement. Having some experience in the use of the various Bostik preparations, I suggest the following method should be applied. Use Bostik " C " and apply thinly to both the surfaces to be joined. When the cement is no longer tacky and does not come away on the fingers, place the articles together and proceed in the normal way, i.e., squeeze out any air bubbles, etc. The length of time required for the adhesive to become non-tacky depends on the length of time the compound has been in stock. I have some at present which takes only five minutes, but I have known it to take up to half an hour.

I omitted to mention that all surfaces must be free from grease before applying the compound, and if there is any likelihood of oil or grease being deposited, there is a sealing compound known as " Bosclyn " lacquer, which can be applied to the edges, thus preventing any oil or grease entering, and subsequently softening the cement.

In passing, I may add that in the last few months, I have used the above method to apply " walkways " to quite a few aeroplanes, and so far none of them has become loose, except those affected by oil seepage, and these have been torn off, rather than blown off.

Yours faithfully,
Bulawayo, S. Rhodesia. W. E. MARTIN.

Queries and Replies

Enquiries from readers, either on technical matters connected with model engineering, or referring to supplies or trade services, are dealt with in this department. Each letter must be accompanied by a stamped, addressed envelope, and addressed : "Queries Dept.," THE MODEL ENGINEER, 23, Great Queen Street, London, W.C.2.

Queries of a practical character, within the scope of this journal, and capable of being dealt with in a brief reply, will be answered free of charge.

More involved technical queries, requiring special investigation or research, will be dealt with according to their general interest to readers, possibly by a short explanatory article in an early issue. In some cases, the letters may be published, inviting the assistance of other readers.

Where the technical information required involves the service of an outside specialist or consultant, a fee may be charged depending upon the time and trouble involved. The amount estimated will be quoted before dealing with the query.

Only one general subject can be dealt with in a single query ; but subdivision of its details into not more than five separate questions is permissible. In no case can purely hypothetical queries, such as examination questions, be considered as within the scope of this service.

No. 9915.—Reducing Voltage
S. M. (Halifax)

Q.—I have a transformer 230 V input and 40 V 3 A output, which I want to be 230 V input with tappings for 24 V and 12 V output. Could you give me details for bringing the voltage down from 40 V to 24 and 12 V ?

R.—The voltage of your transformer can only be reduced by re-winding. Dismantle the transformer, and unwind the secondary, carefully counting the present turns of wire. Divide these turns by 40, and this will give you the turns per volt of the present winding. Having determined a figure by division, use this figure for your 24 and 12 V calculation, multiplying by the figure obtained, the secondary voltages you want, and this will give the turns per volt for the new windings. For the 24 and 12 V arrangement, you can wind two separate secondaries or bring out a tap at the 12 V position and continue winding until the 24 V position is reached, that is, the end of the winding.

No. 9916.—An Auto-transformer
E. K. (Leeds)

Q.—I would like to construct an auto-transformer for a projector lamp. Details are : input 200 V, 50 cycles a.c., output 110 V, 250 W, and would appreciate your advice.

R.—An auto-transformer is no different from the ordinary transformer so far as design is concerned. With the auto-transformer, instead of having two separate windings, the primary and secondary are combined as one winding. An auto-transformer would be cheaper to make, as less copper would be required ; for example, if we have a transformer with separate primary and secondary windings, and the primary were to have 100 turns and the secondary 10 turns, the same effect may be obtained by winding one coil of 100 turns, ten of which will be the secondary, but of a larger size of wire. Calculate for a primary winding, arranging the tap position at the calculated turns for this secondary part of the whole winding. The secondary section would, in most cases, be larger in size than the primary, that is to say the wire size. We would point out, that with the use of an auto-transformer where the secondary leads are likely to be handled, there can be the full supply pressure to earth on the secondary winding. Where the supply is earthed on one side, the inner end of the primary winding should be connected to this side of the supply.

No. 9917.—Radio Suppressor
J. M. (Aberdeen)

Q.—Would you kindly explain to me how to connect a radio suppressor, to an electrical circuit, so as to silence two or three motors from the one suppressor ? These motors, of course, are plugged into 2-pin sockets as required. If not possible, how should the suppressor be connected, to the motor brushes or to leads terminals ? Is it essential to have an earth from a water main, or is the motor frame good enough for earthing ?

R.—Where radio interference derives from electric motors, it is the usual practice to fit suppressors to each motor. This is done by connecting a suitable suppressor. The suppressor is a condenser assembly having three leads ; the condensers are connected in series and a tap is brought out from the mid. point connection. The unit is connected by attaching the outer leads, one to each brush, and the mid. point connection is connected to earth. The metal body of the motors is not an earth in itself ; it requires to be solidly connected to earth, preferably to the supply company's earth wire brought in with the service cable. Alternatively, the earth can be provided by using the water supply pipe on the main side of the supply, or a length of copper rod may be driven in the ground and kept in a moist condition. The suppressor unit will vary with the size of the motor, and we suggest that you contact Messrs. Bulgin & Co. Ltd., Abbey Road, Barking who are specialists in the manufacture of these suppressors. If you give them full details of your motors, they will be able to offer a suitable suppressor.

No. 9914.—Thermo-couple R.F. Ammeters
J. S. (Newport)

Q.—Can these meters (*ex*-R.A.F.) be used to measure d.c. and 50 cycle a.c.? I have made comparisons with an 0-3.5 A meter and it appears to indicate the same current when the circuit is fed either with d.c. or the same R.M.S value of a.c. I have another instrument which has the thermo-couple burnt out, but the moving coil unit is intact. This has an F.S.D. of 1.5 mA. I should be glad to have your ideas on the conversion of this movement to read 0-300 V, a.c., 50 cycles, perhaps using one of the small crystal rectifiers now on the surplus market.

R.—Meters of the thermo-couple type can be used to measure either a.c. or d.c. currents. The crystal type of rectifiers you mention are unsuitable for use with a meter. The measurement of a.c. currents is carried out by the use of a suitable type of bridge-connected rectifier. These rectifiers are made specially for this purpose by The Westinghouse Brake & Signal Co. Ltd., 82, York Way, Kings Cross, London, N.1. We suggest that you write to these people explaining exactly what you wish to do, they will send you some very helpful data as to the use of small meters for both d.c. and a.c. operations.

No. 9907.—Error in Lathe Centre Alignment
H. C. H. (Swansea)

Q.—I am a newcomer to the hobby of model engineering and would be glad of a little expert advice. I purchased a new $3\frac{1}{2}$ in. B.G., S.C. lathe a few months ago, and am beginning to get used to lathe work in general. Quite by accident, I noticed that when the tailstock centre and headstock centre met, the headstock centre point is about $\frac{1}{16}$ in. below the tailstock centre point. What effect will this have on accurate turning, and how can it be overcome? I might add that both centres and their sockets are perfectly clean; also, when the centres are interchanged, the same effect occurs.

R.—The error which you describe in the alignment of the headstock and tailstock centres of your lathe seems rather excessive, and the only way to correct this would be to machine away the base of the tailstock until the centres line up exactly. If this is done, great care should be taken to maintain the base surface of the tailstock exactly parallel with the axis of the barrel.

Misalignment of the tailstock centre makes it extremely difficult to do centre-drilling or drilling accurately in the lathe, and would also affect the setting of the tool point when turning work between centres, as the tool, correctly set for the height of the tailstock centre, would be too high near the head end.

No. 9911.—An Old Petrol Engine
J. T. H. (Marston)

Q.—I have recently bought a 1 h.p. petrol engine, but I am not getting satisfactory results, although everything appears to be in good order. I had to dismantle the two flywheels and crank for removal, and am not sure about the timing. The engine is of the old type, water-cooled, and the magneto fires from a rod at the side of the engine from the cam-wheel next to the crank (the click-off type). A spring is missing from the inlet-valve, and I am not sure what strength this should have, as the engine sucks the valve open and the rod mentioned works the exhaust only. I do not quite understand the petrol supply, as the carburettor appears to suck up too much fuel. Could you please advise me regarding petrol system, correct timing, and the inlet spring?

R.—It would appear that this particular type of engine is one which was manufactured a good many years ago, and is of a somewhat crude type, though these engines give reasonably good results in practice. The timing depends entirely on the control of the exhaust valve, which should open from 30 deg. to 45 deg. before the end of the firing stroke, and close at or near the top dead-centre position on the next stroke. When once this timing has been determined, the magneto timing, which is operated from the exhaust push-rod, should automatically be correct. The spring of the inlet-valve should be very light, as it has to be operated by engine suction. With regard to the carburettor, the type usually fitted to these engines was rather crude, and in most cases, petrol was drawn up from a low level tank by a screwed needle-valve. With such carburettors, there is no automatic control of mixture, but both the air intake shutter and also the screwed needle-valve have to be adjusted to supply the correct proportions of air and petrol.

No. 9912.—Faults in Home Castings
L. E. P. (Goldalming)

Q.—I have been trying to make a few simple aluminium alloy castings using car pistons and odd aluminium castings from old cars, as described in THE MODEL ENGINEER from time to time, but in most cases the finished article, usually a square block or circular rod, looks well until machined, when very small blow-holes or specks become apparent. I should be most grateful for any information to overcome this difficulty, it might also help others.

R.—It would appear, from the description of your methods of casting aluminium, that the principle trouble is due to gassing of the metal, which, in turn, may be due to one or other of a number of causes. The most likely cause is that you are pouring the metal at too high a temperature, and this is confirmed by your statement that the molten metal is approximately medium cherry red when viewed in the dark just before pouring. It is a common practice in foundries to heat the metal to a sufficiently high temperature to ensure complete fluidity and then allow it to cool until a port wine coloured film is seen on the surface; this gives an opportunity for any gas in the metal to escape. Other possible causes of gassing are foreign matter in the scrap metal used, or possibly an unsuitable grade or mixture of metal. We suggest you may be able to obtain some useful information from the article by Mr. A. L. Headech entitled "Amateur Foundry Work" published in the issues dated May 25th, June 8th and 15th, 1950.